Designing USB Audio Class Devices for Mac OS X

Session 506

These are confidential sessions—please refrain from streaming, blogging, or taking pictures.

Designing USB Audio Class Devices for Mac OS X

Alison Hughes
Audio Software Engineer, Multimedia

Session Roadmap

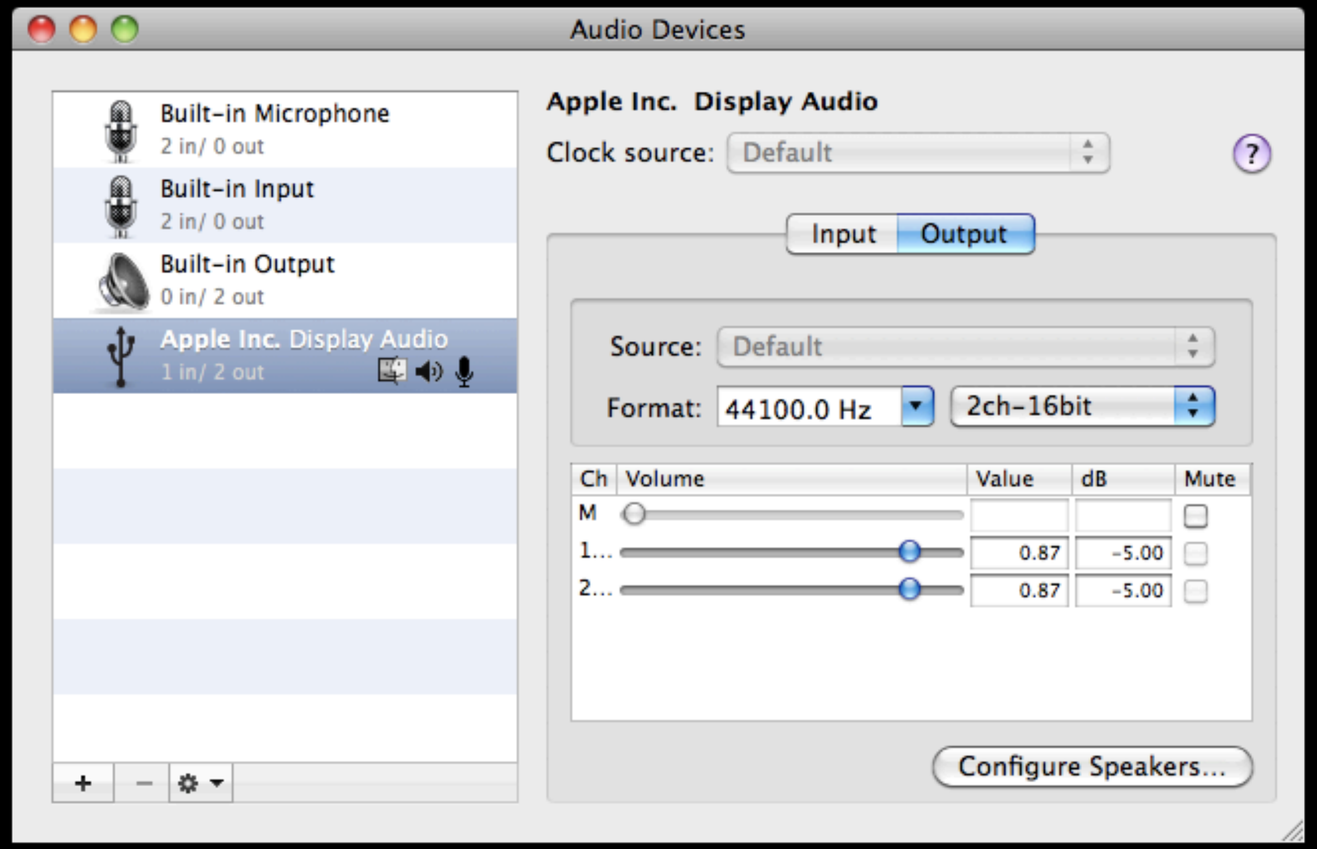
- Introduction
- Breathe easy. We've got the driver covered.
- Four tips for the best plug-and-play user experience
- 2.0 USB Audio in Snow Leopard
- Final thoughts and Q&A

Introduction

Introduction

- AppleUSBAudio (AUA): The basics

Audio MIDI Setup



USB Audio 1.0

USB Audio 2.0

High Speed Device + USB Audio 1.0 Descriptors

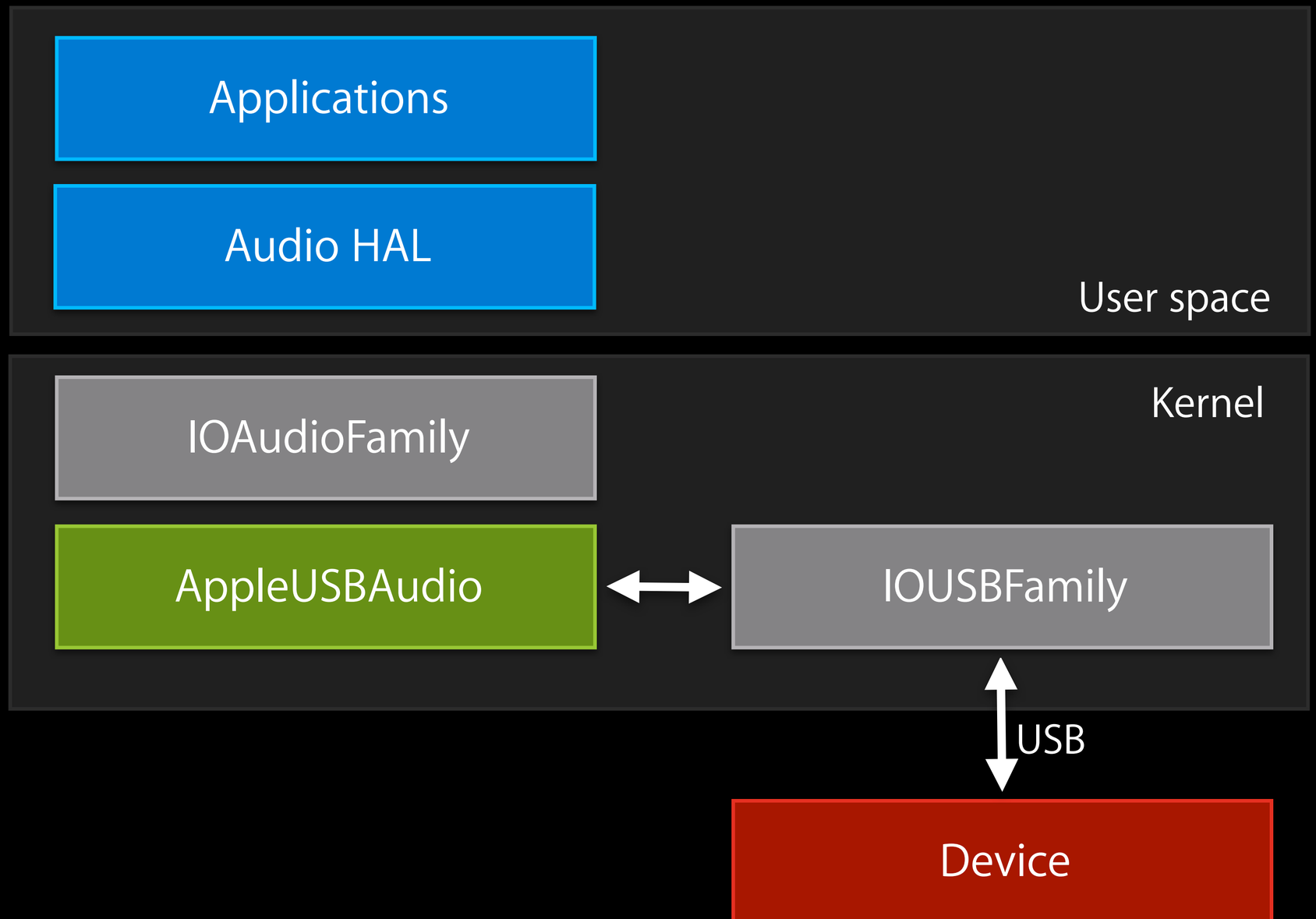
Introduction

- AppleUSBAudio (AUA): The basics

Introduction

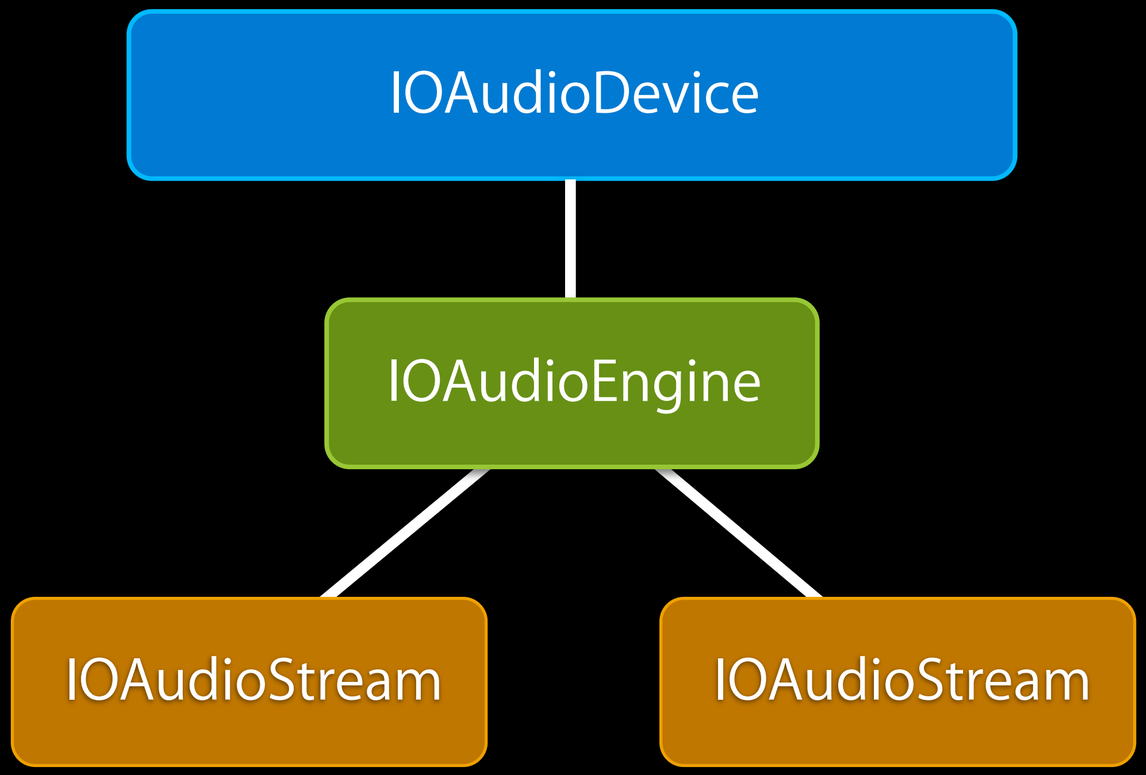
- AppleUSBAudio (AUA): The basics
- AUA in the system architecture

Mac OS X Audio Stack



Audio Hardware Entities

Core Audio



Why Go Class Compliant?

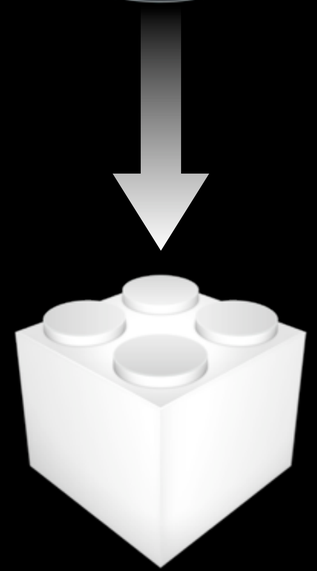
Class compliant is the way to go.

- Reduce your development costs

Development Cost

Firmware

+



Development Cost

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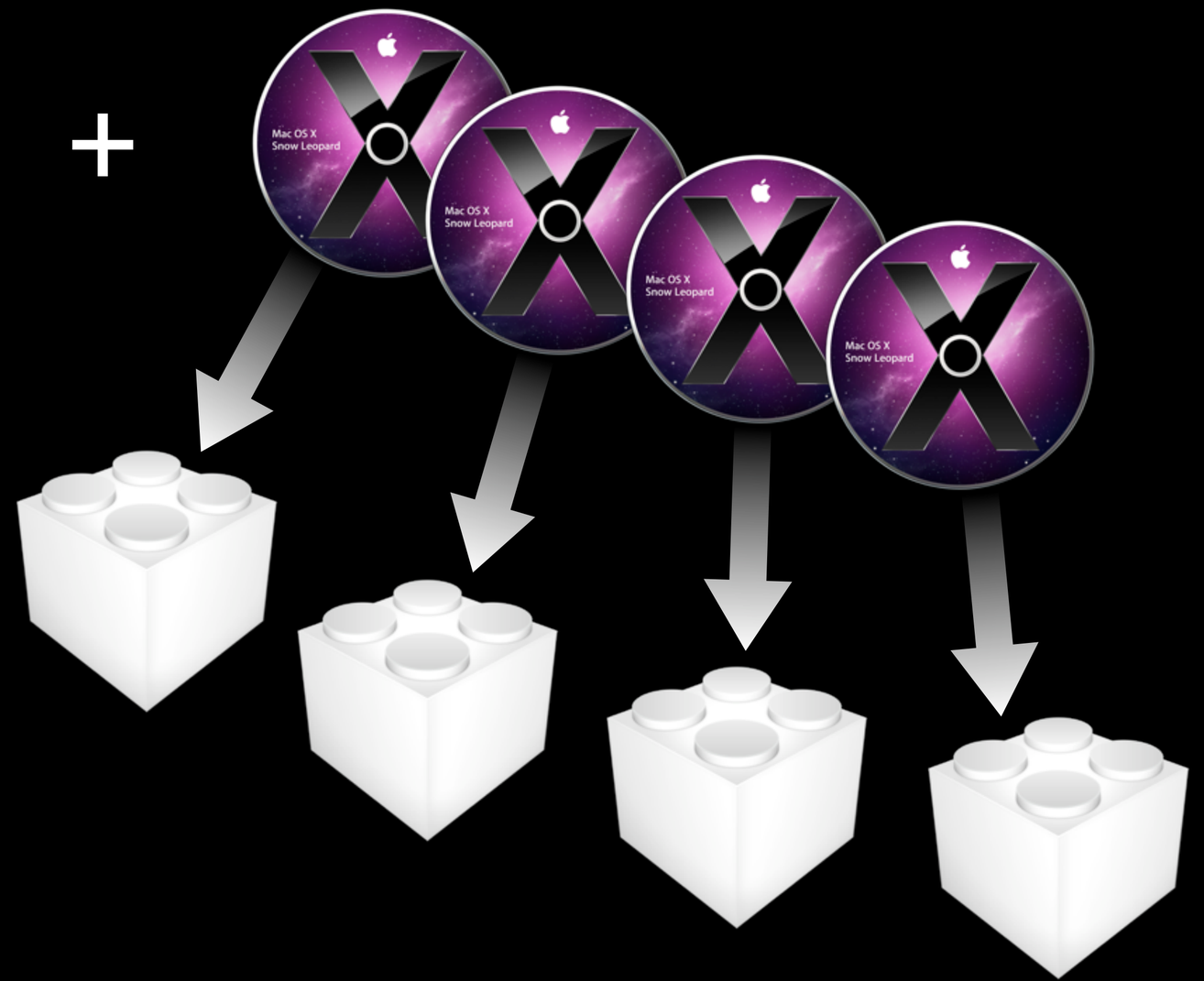

Development Cost

Firmware

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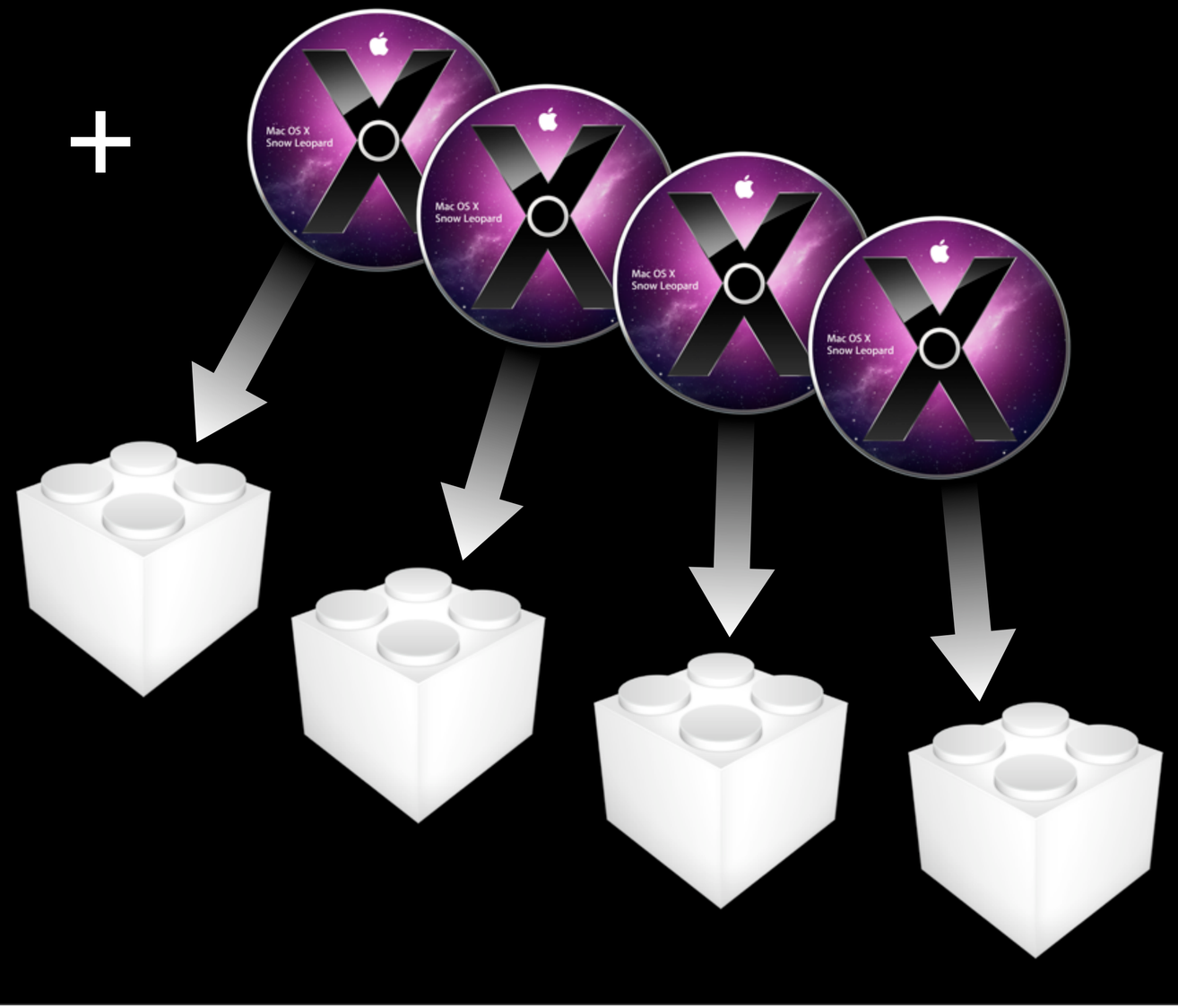

Class compliant is the way to go.

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- Plug and play

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- Extensive free driver testing

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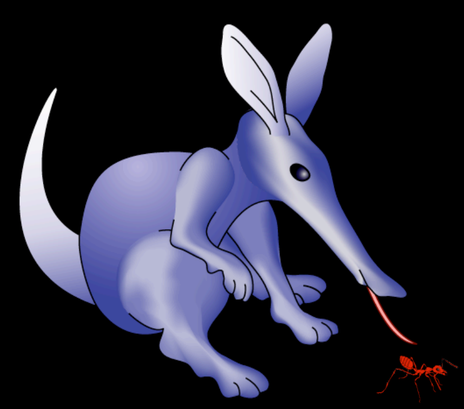
- Extensive free driver testing
- Lots of support and resources available

USB Prober

ADC



Bug Reporter

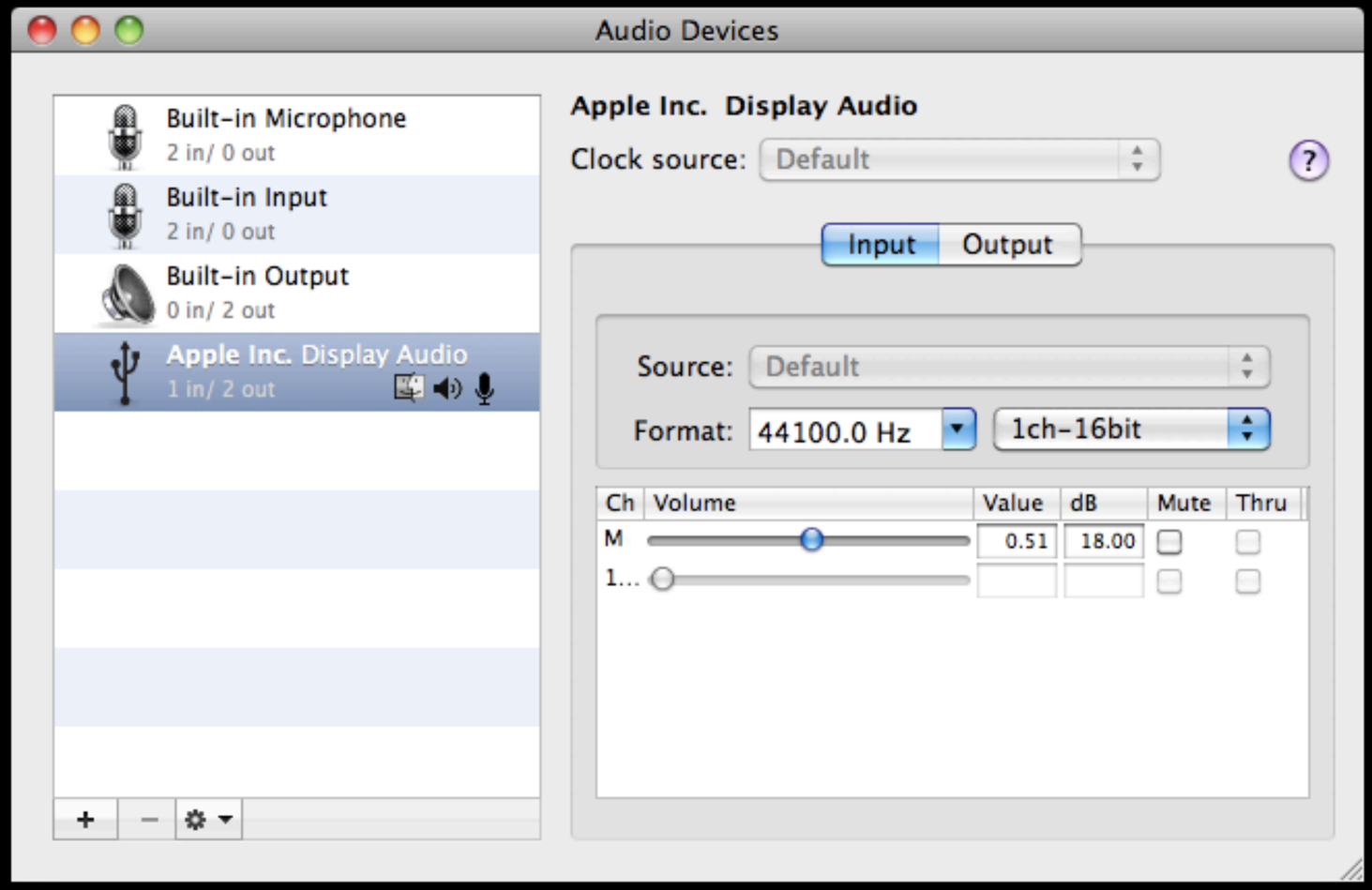
Class compliant is the way to go.

- Reduce your development costs
- Plug and play
- Extensive free driver testing
- Lots of support and resources available
- Plug-ins and custom control panel

4

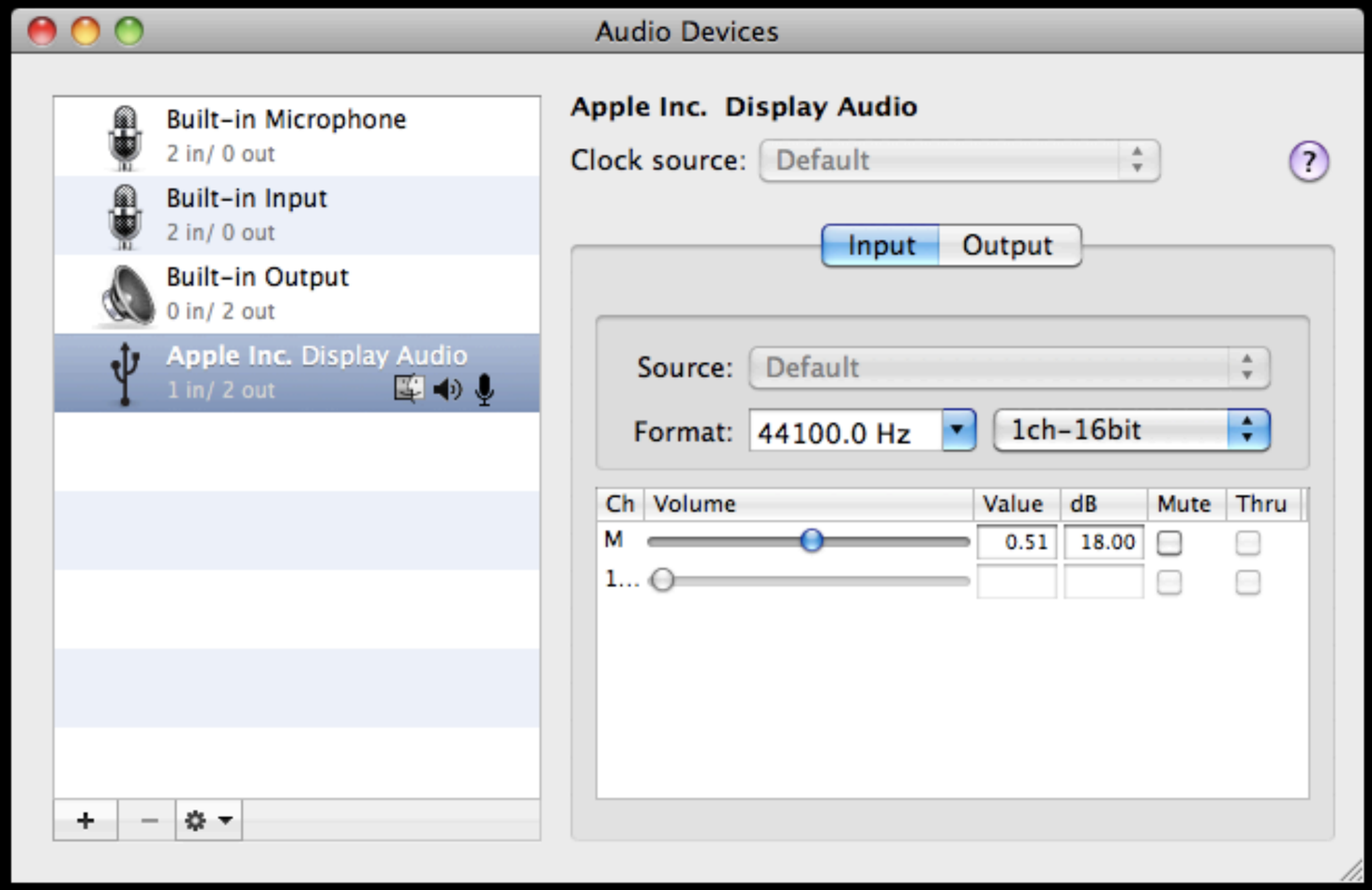
Tip #1: Controls

- Volume and mute



Tip #1: Controls

- Volume and mute
- Play through a.k.a. “Thru”
- Update host of control setting changes



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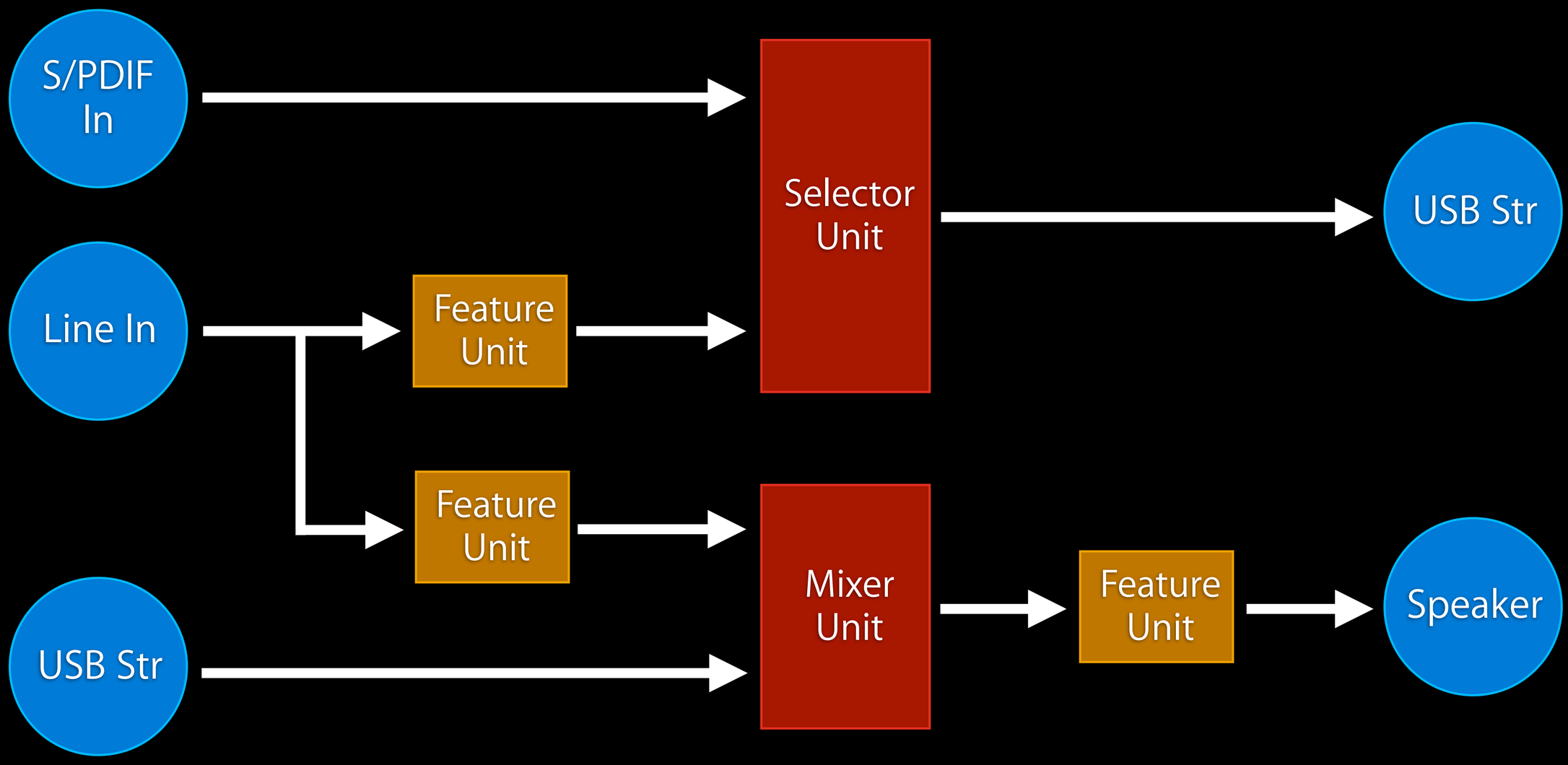

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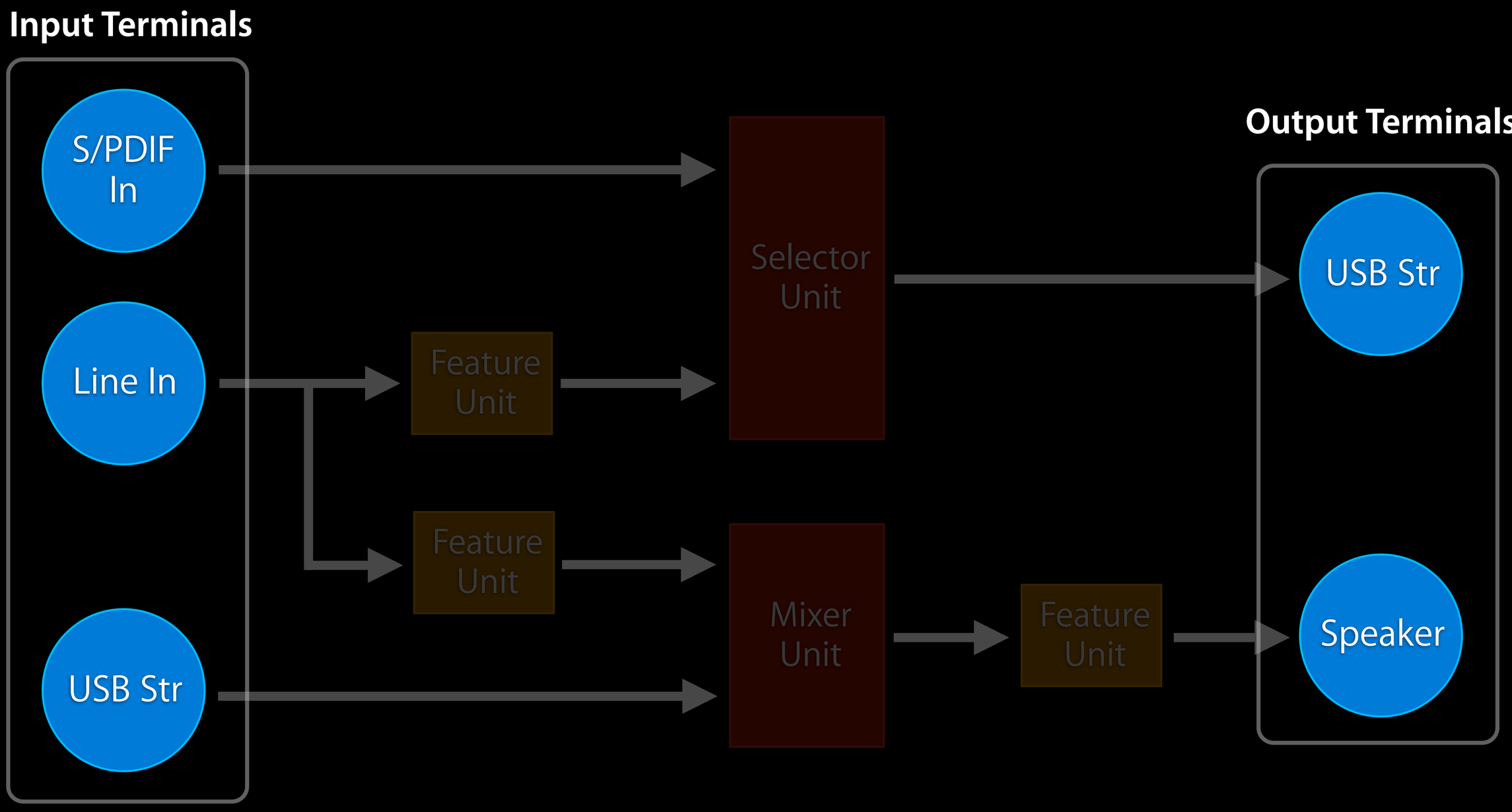

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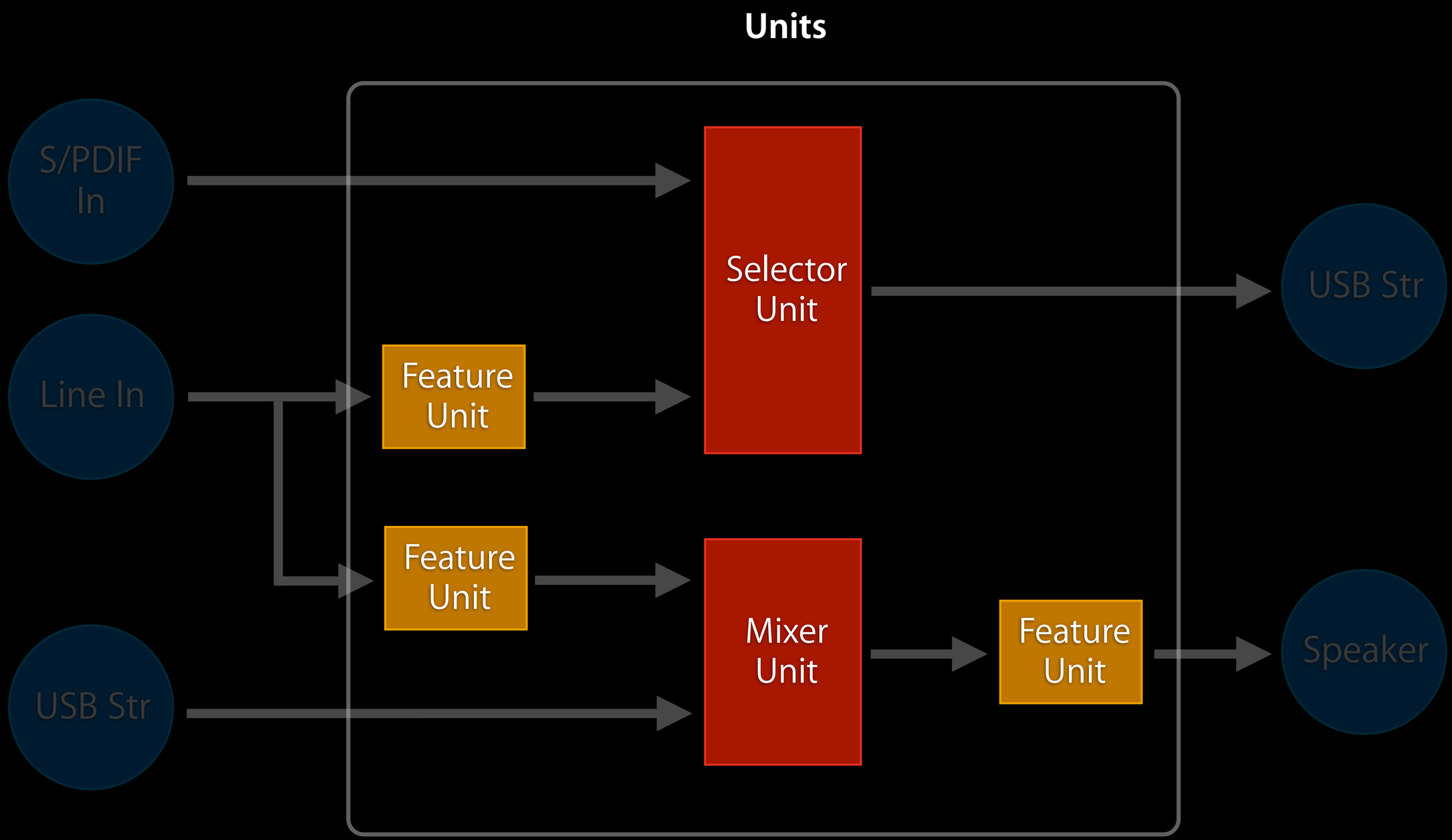

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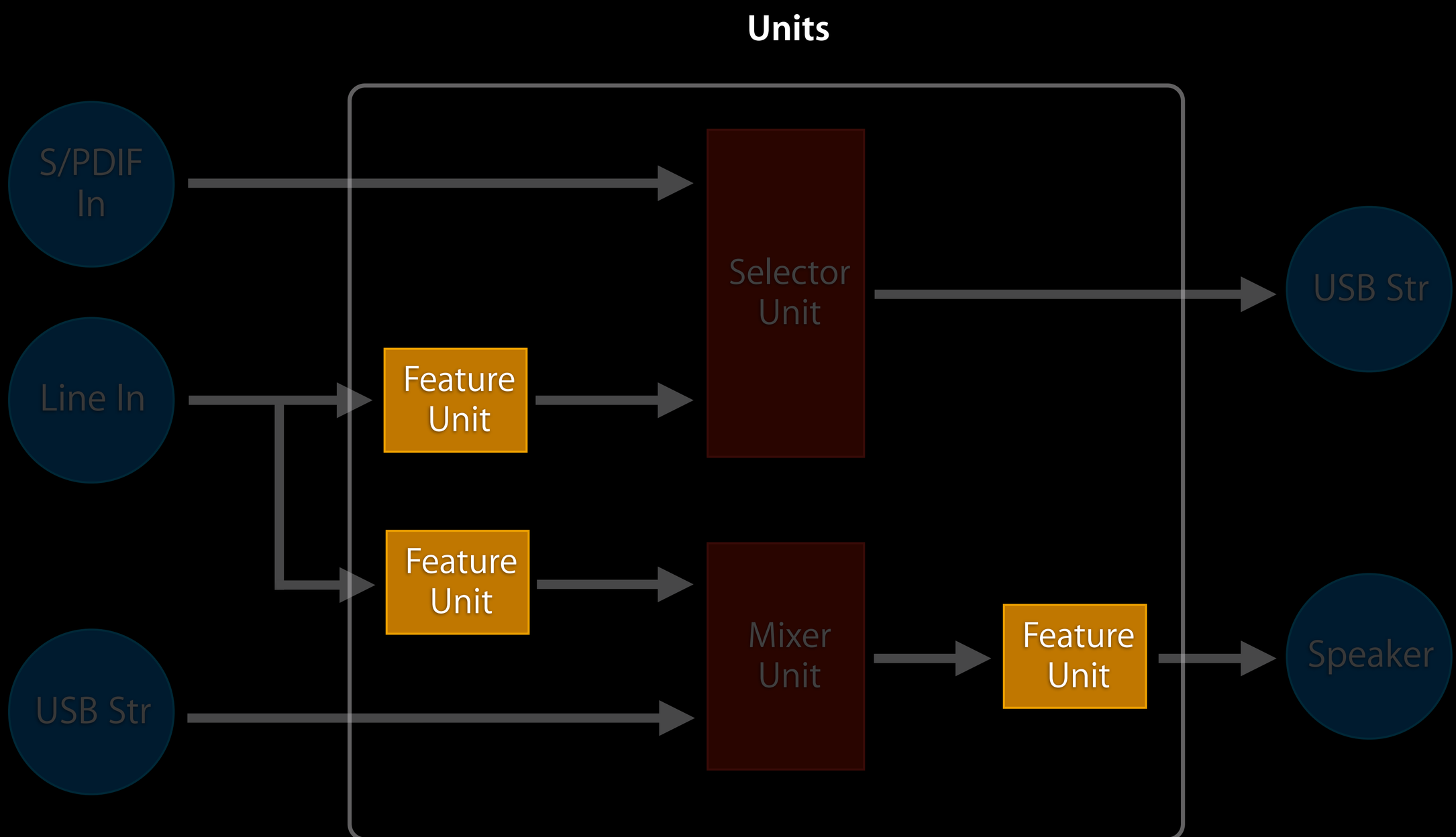

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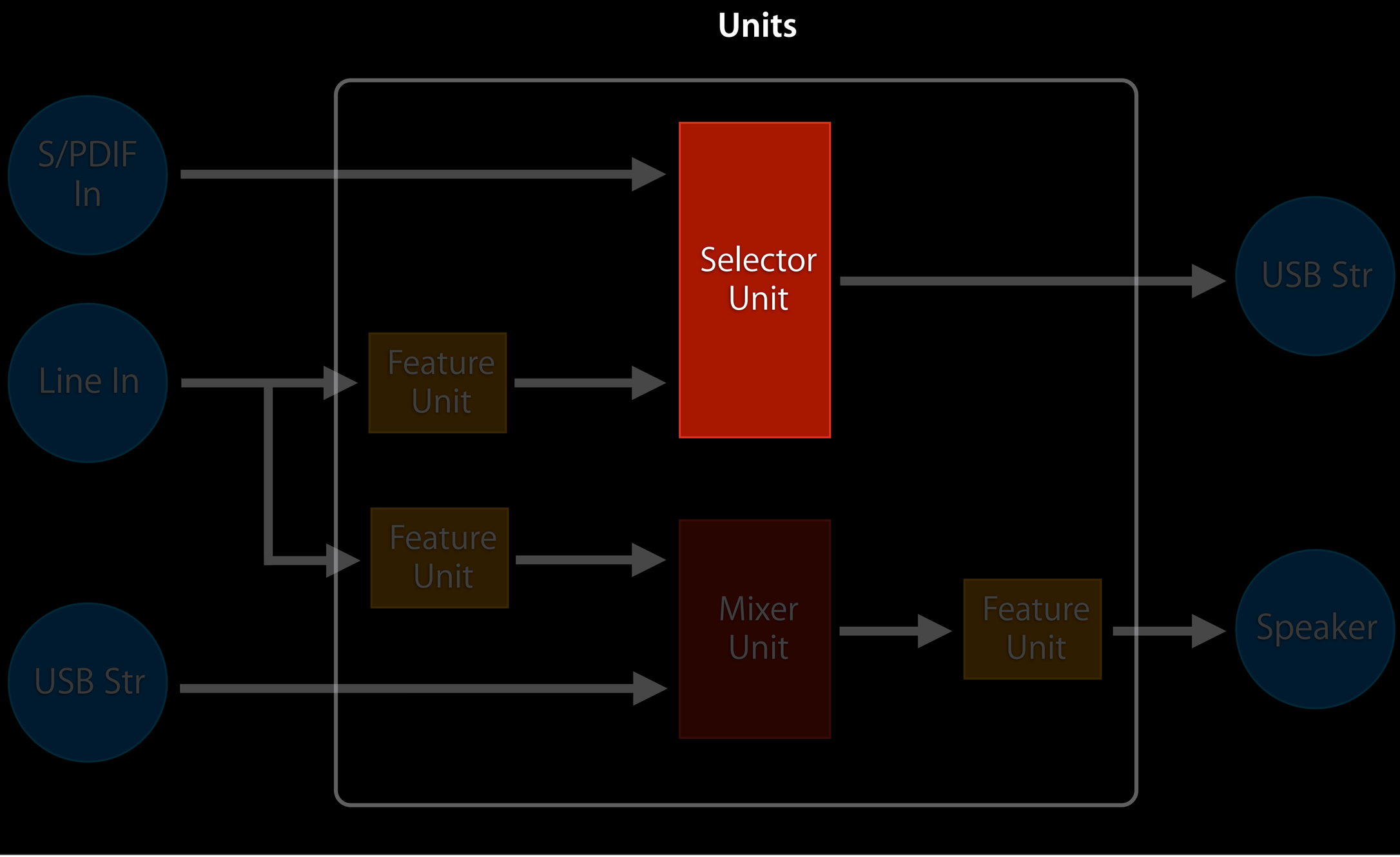

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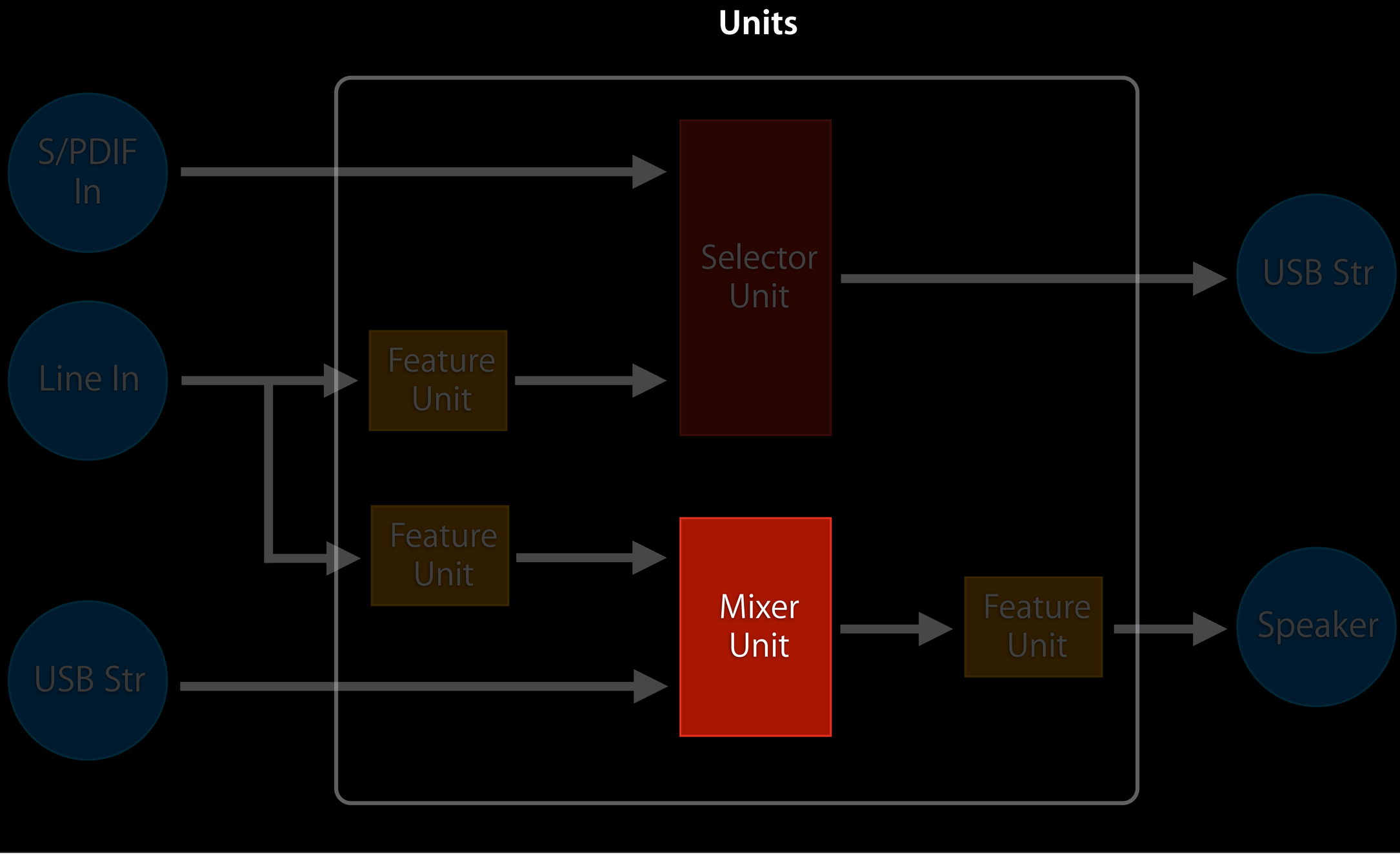


Mixer Unit

Section 4.2.7.6 (2.0 USB Audio Specification)

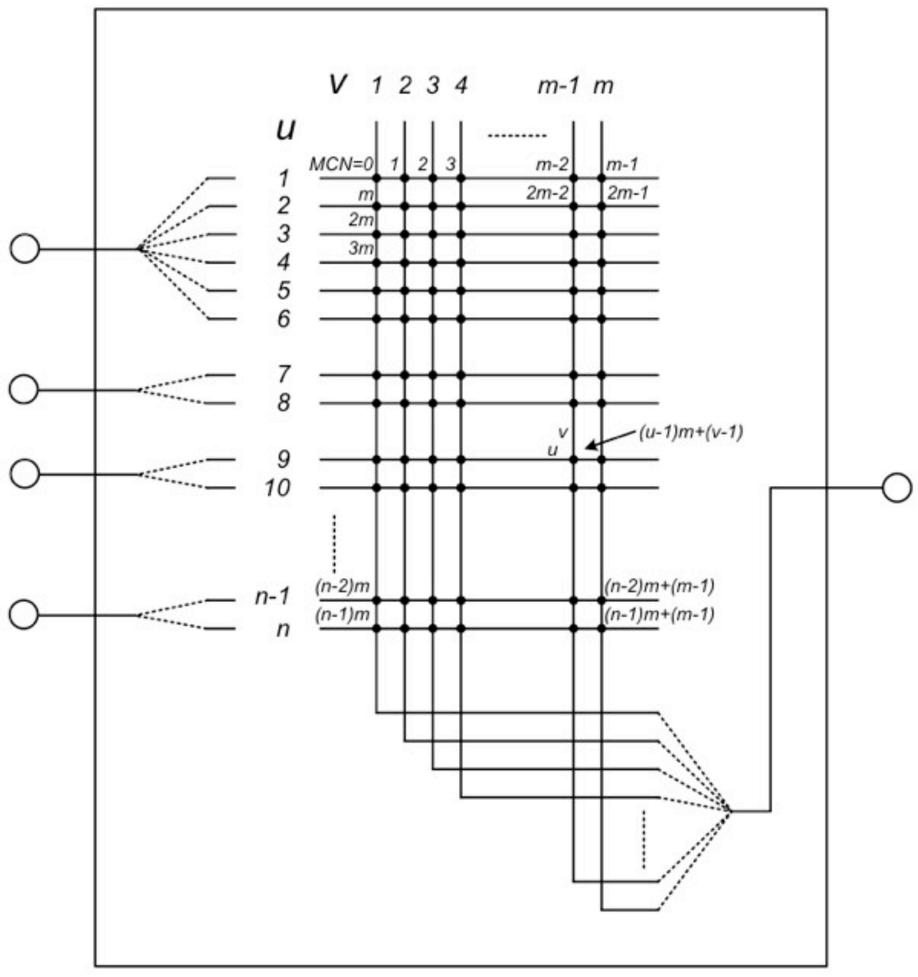
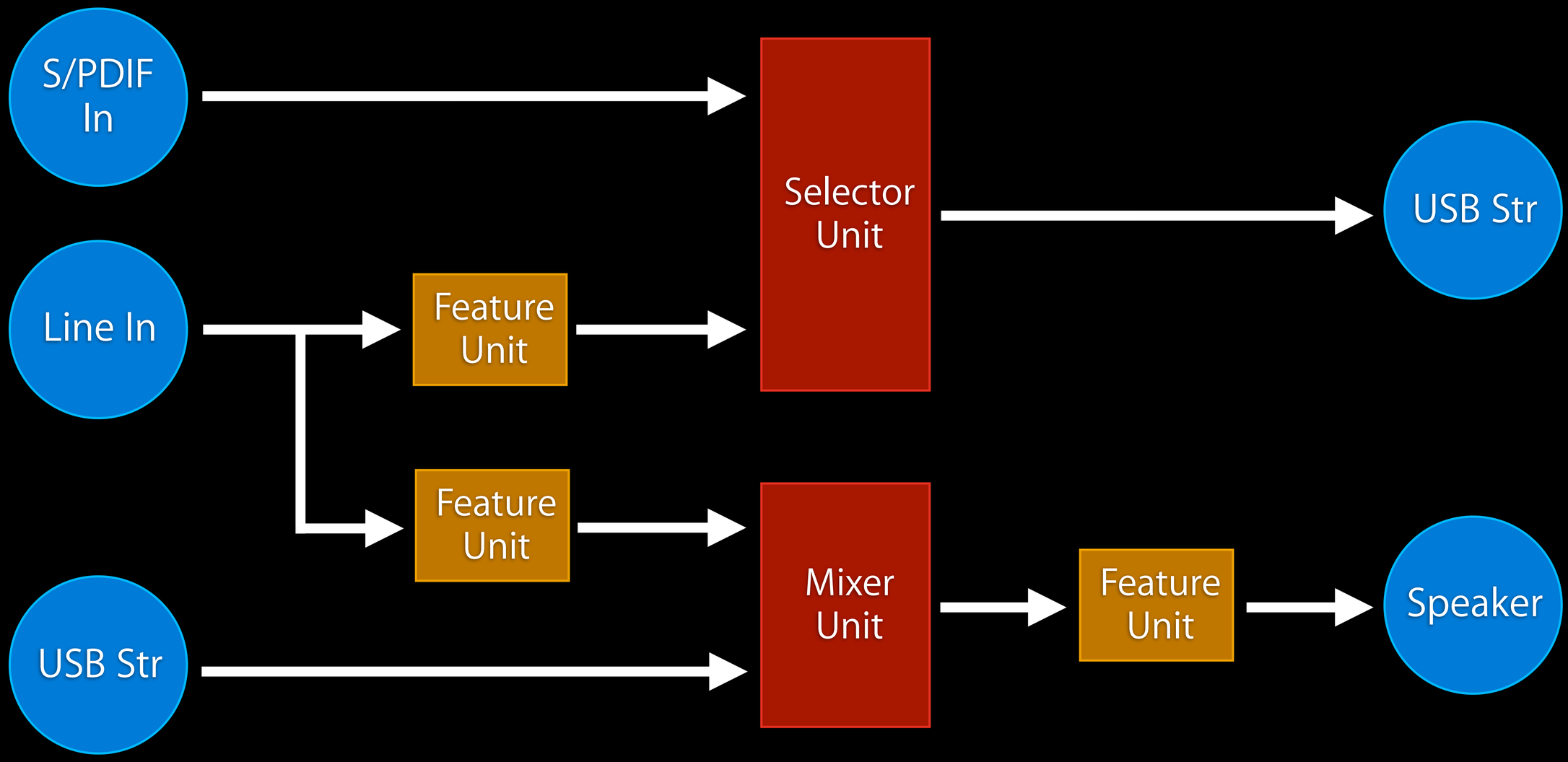


Figure 4-1: Mixer internals

Tip #1: Controls

Volume and Mute: Input



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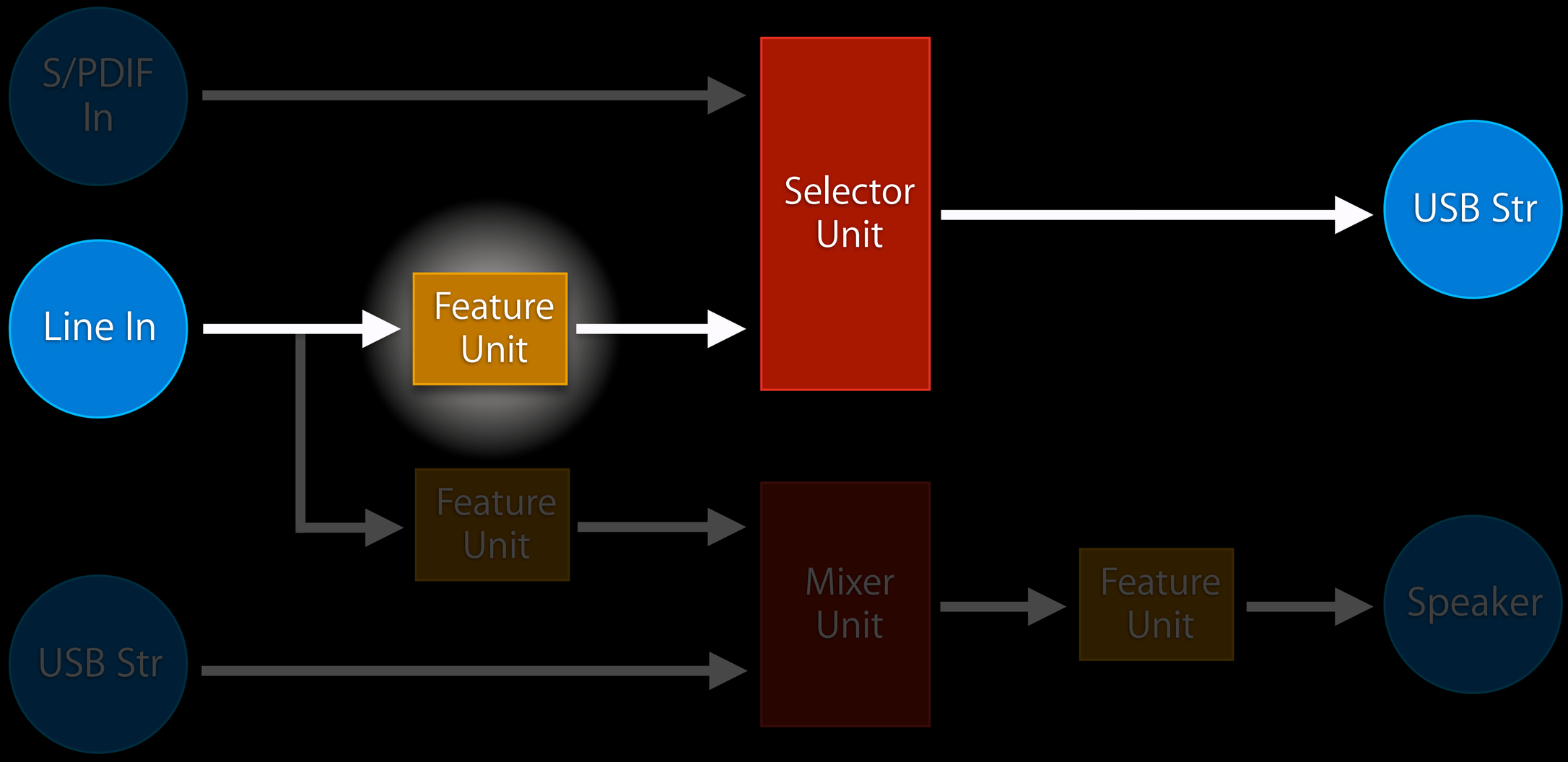
Volume and Mute: Input



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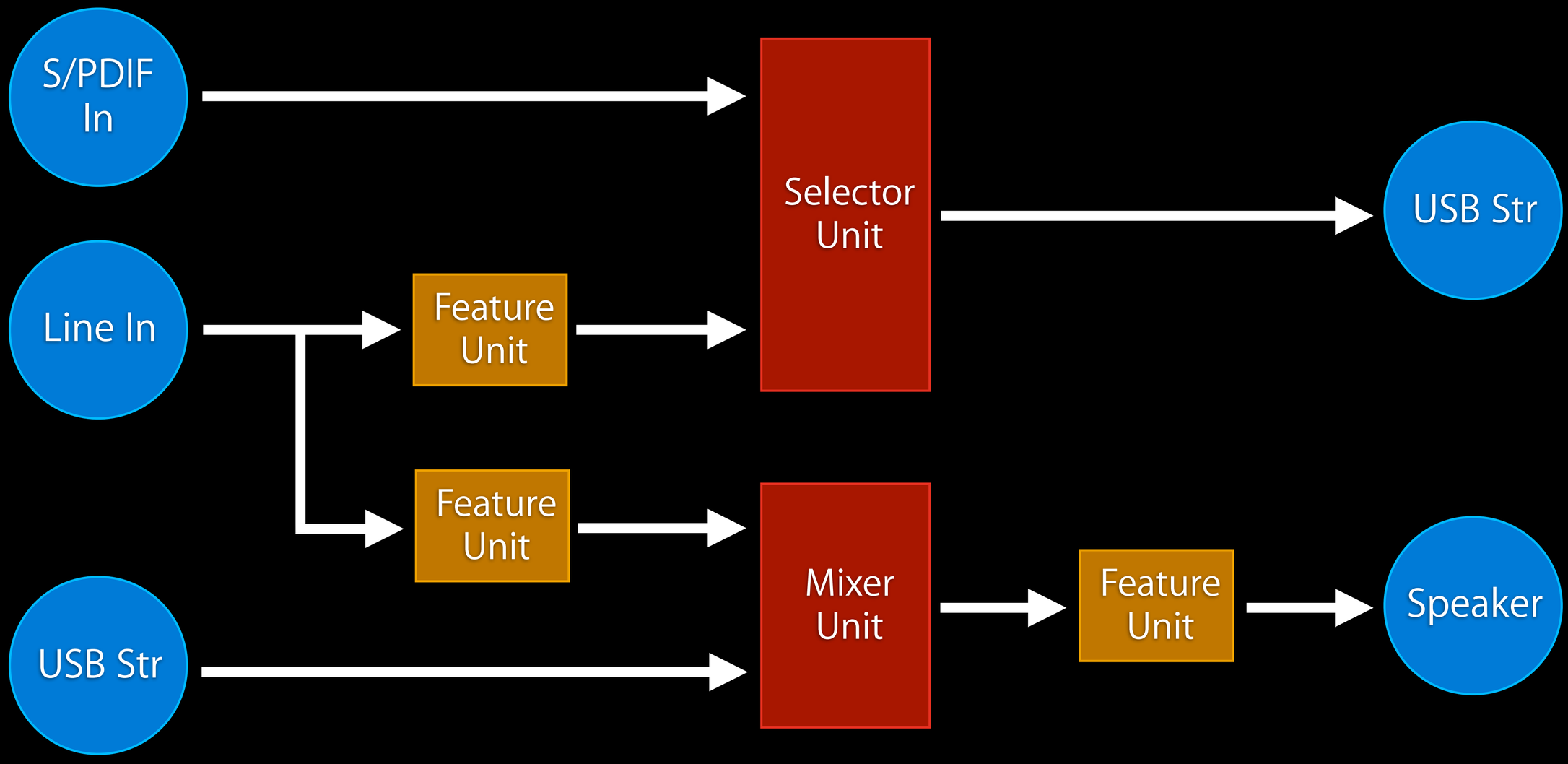
Volume and Mute: Output



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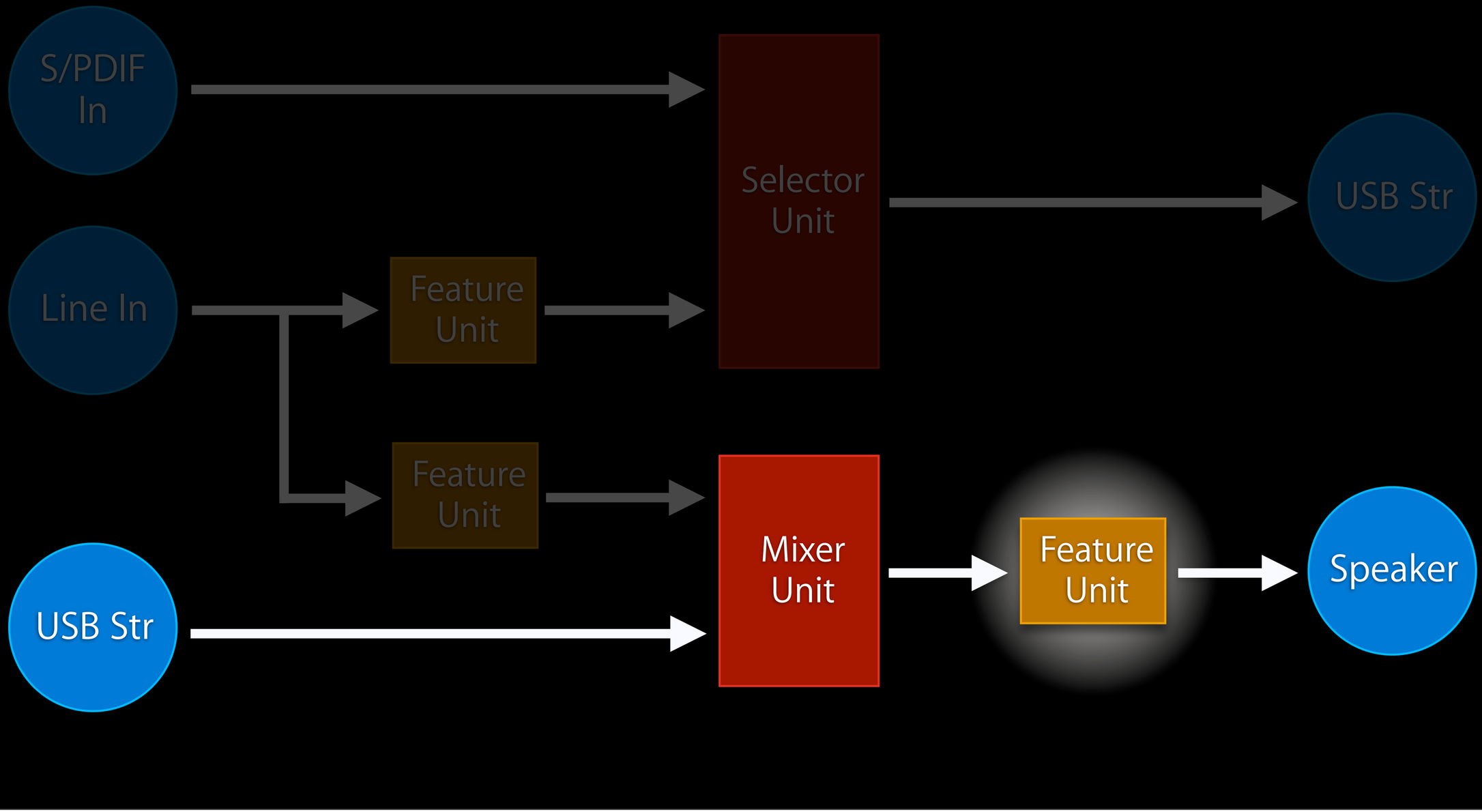
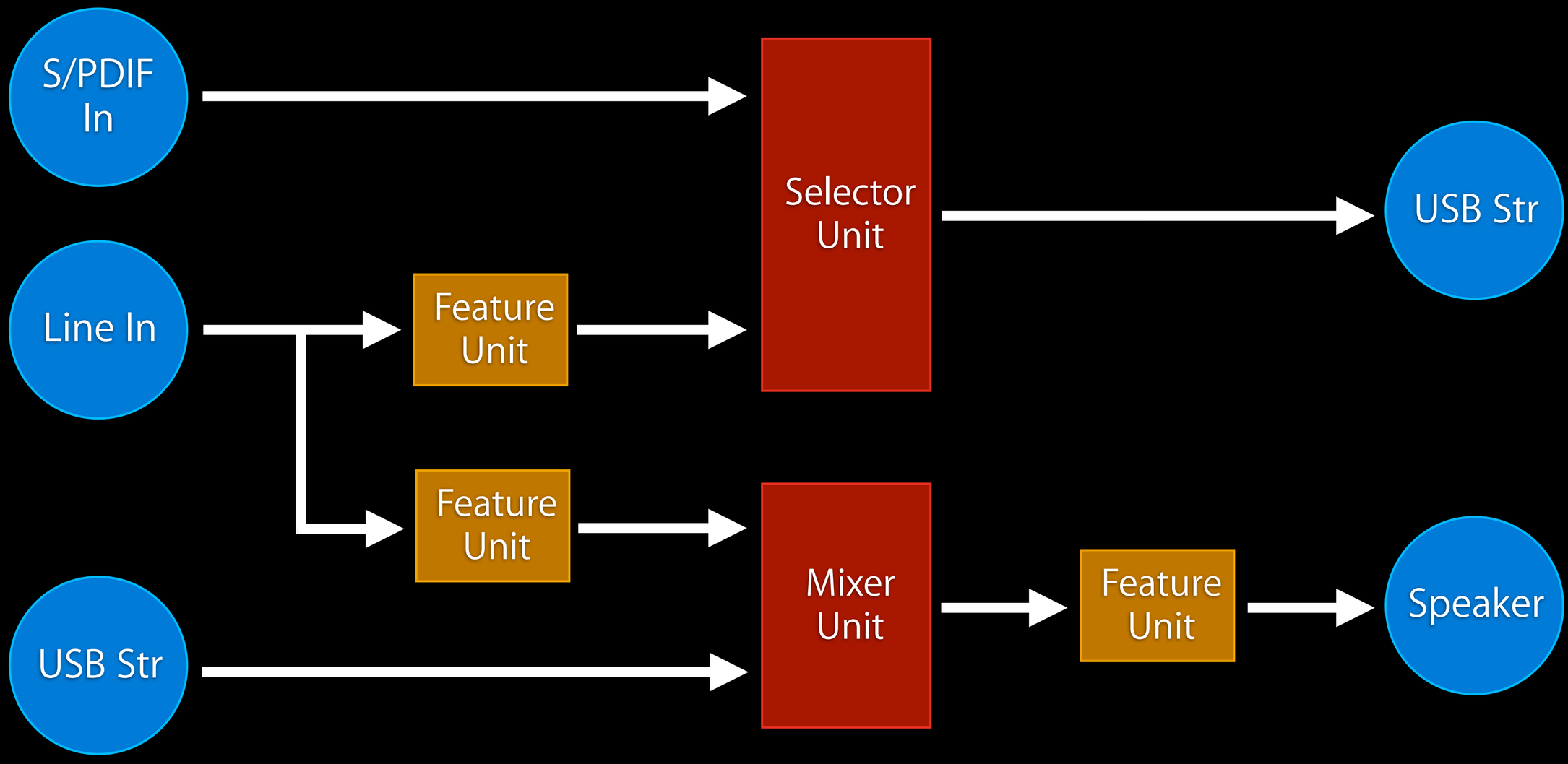
Volume and Mute: Output



Tip #1: Controls

"Thru"



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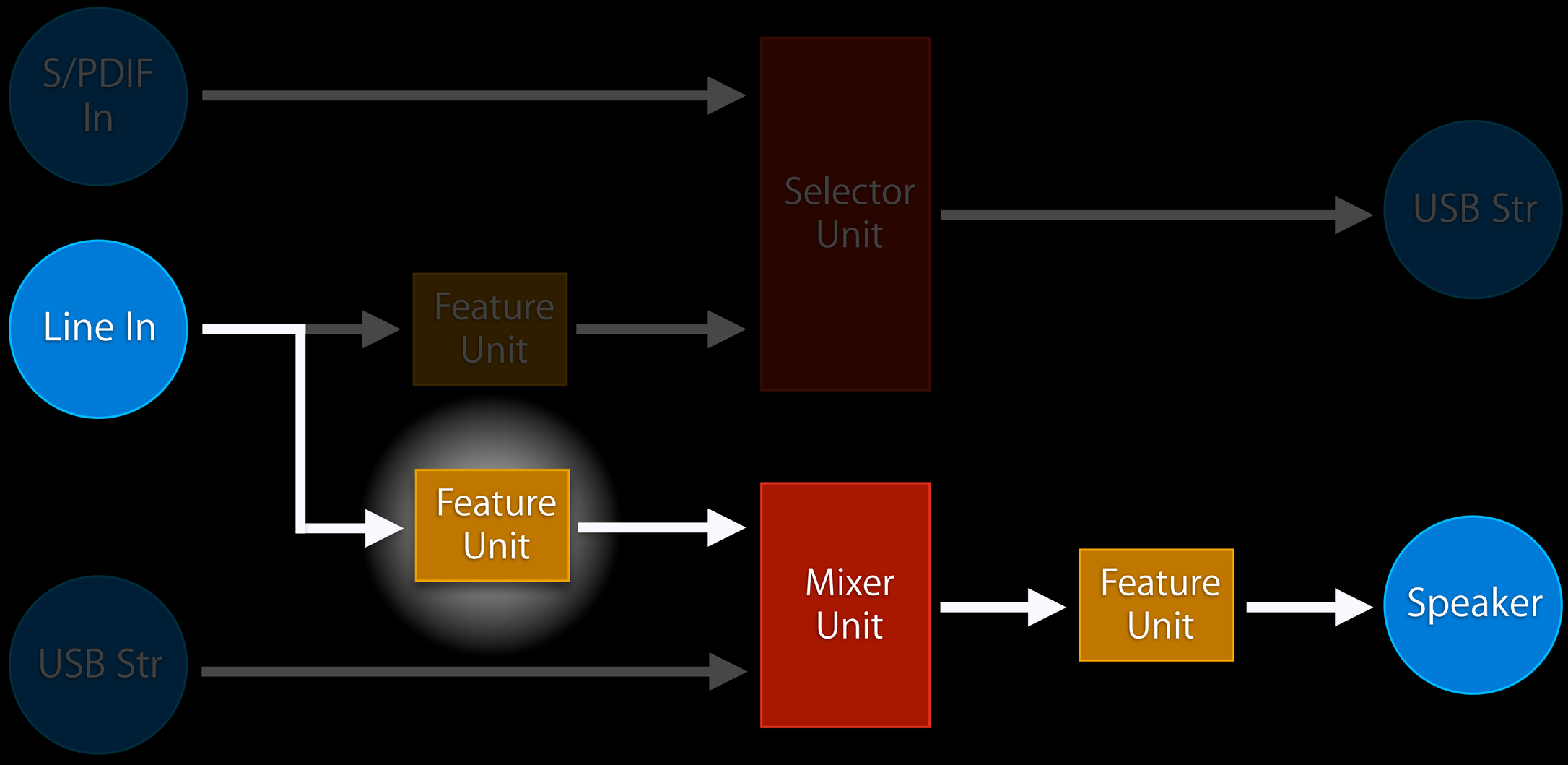
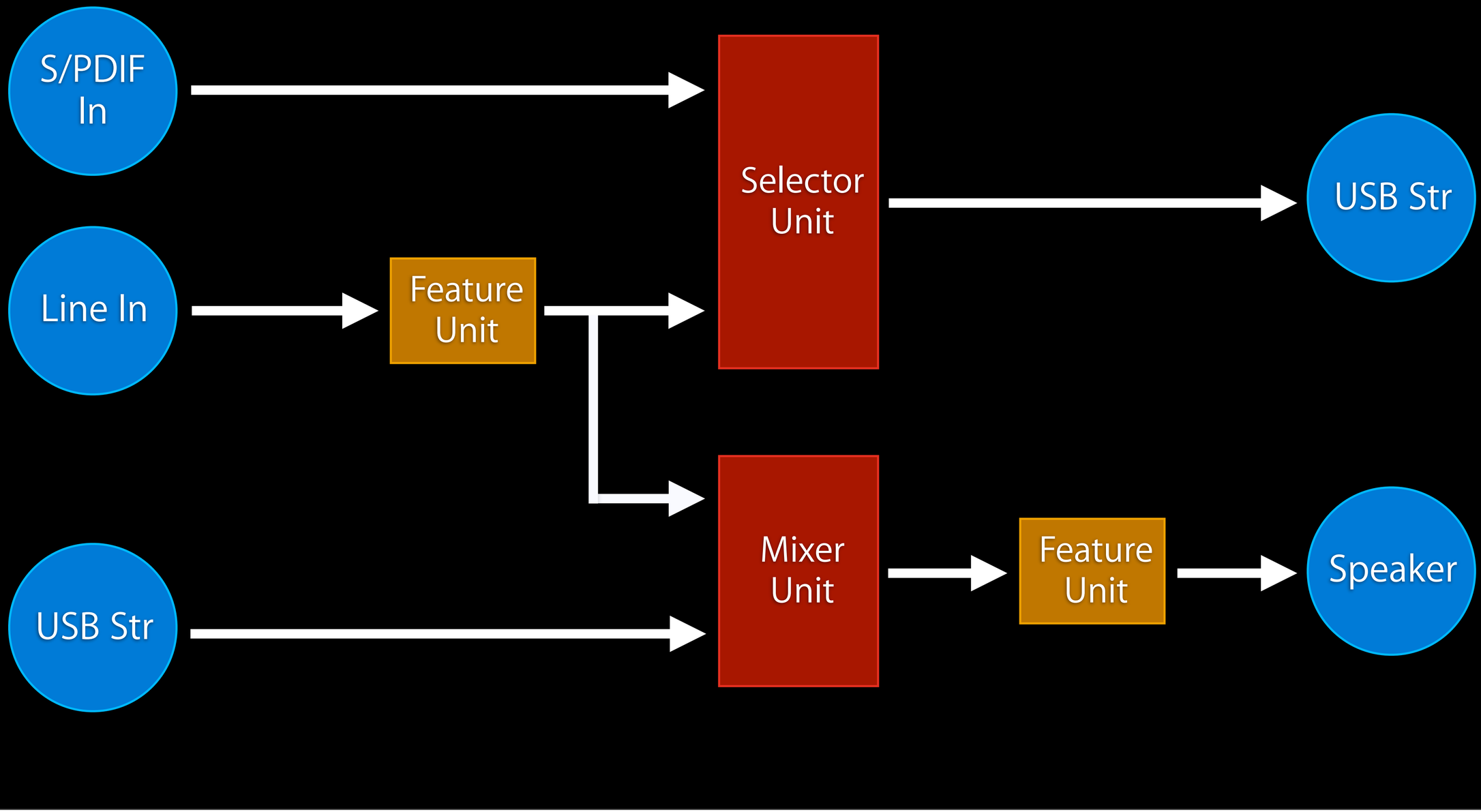


Tip #1: Controls

"Thru": What NOT to do



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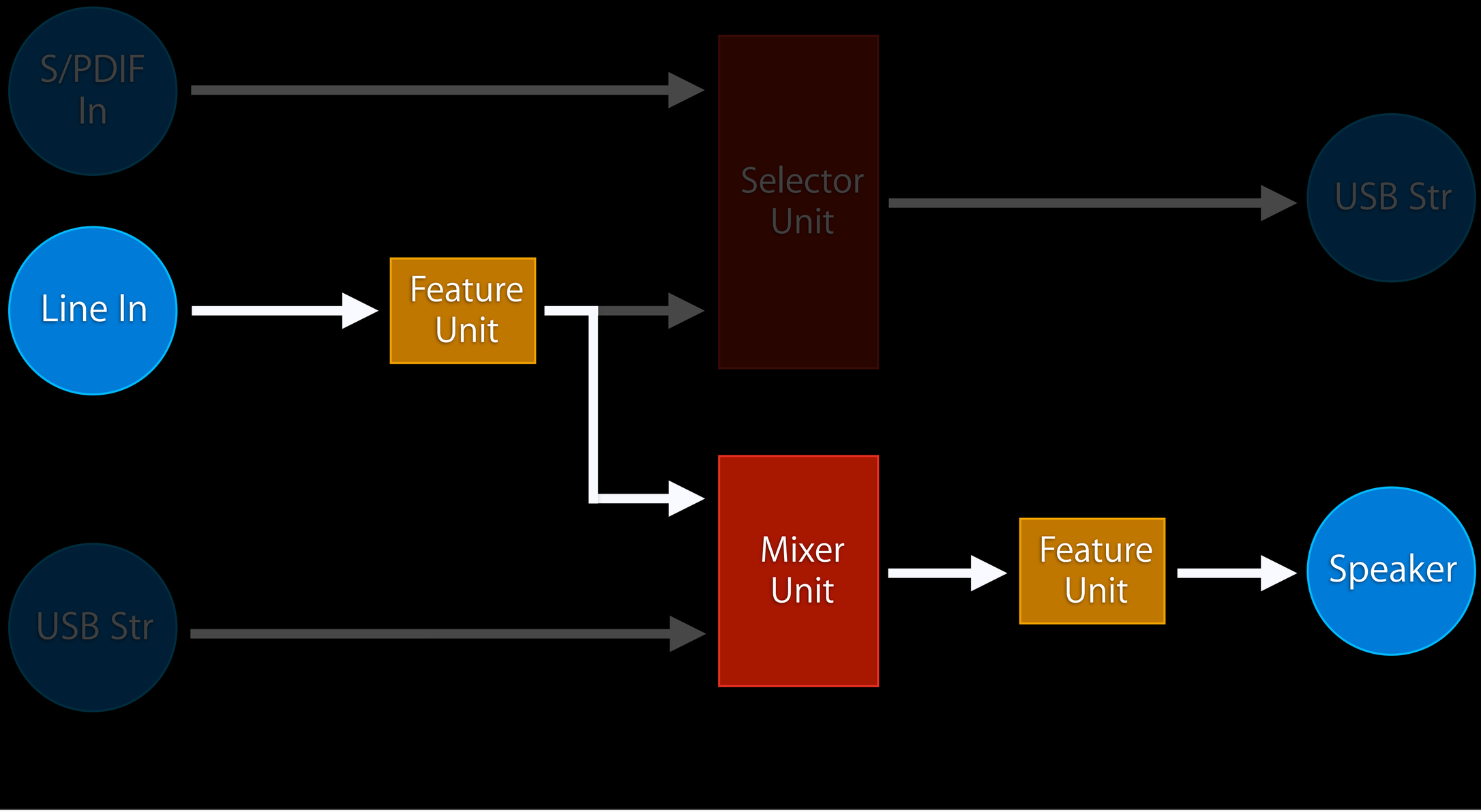

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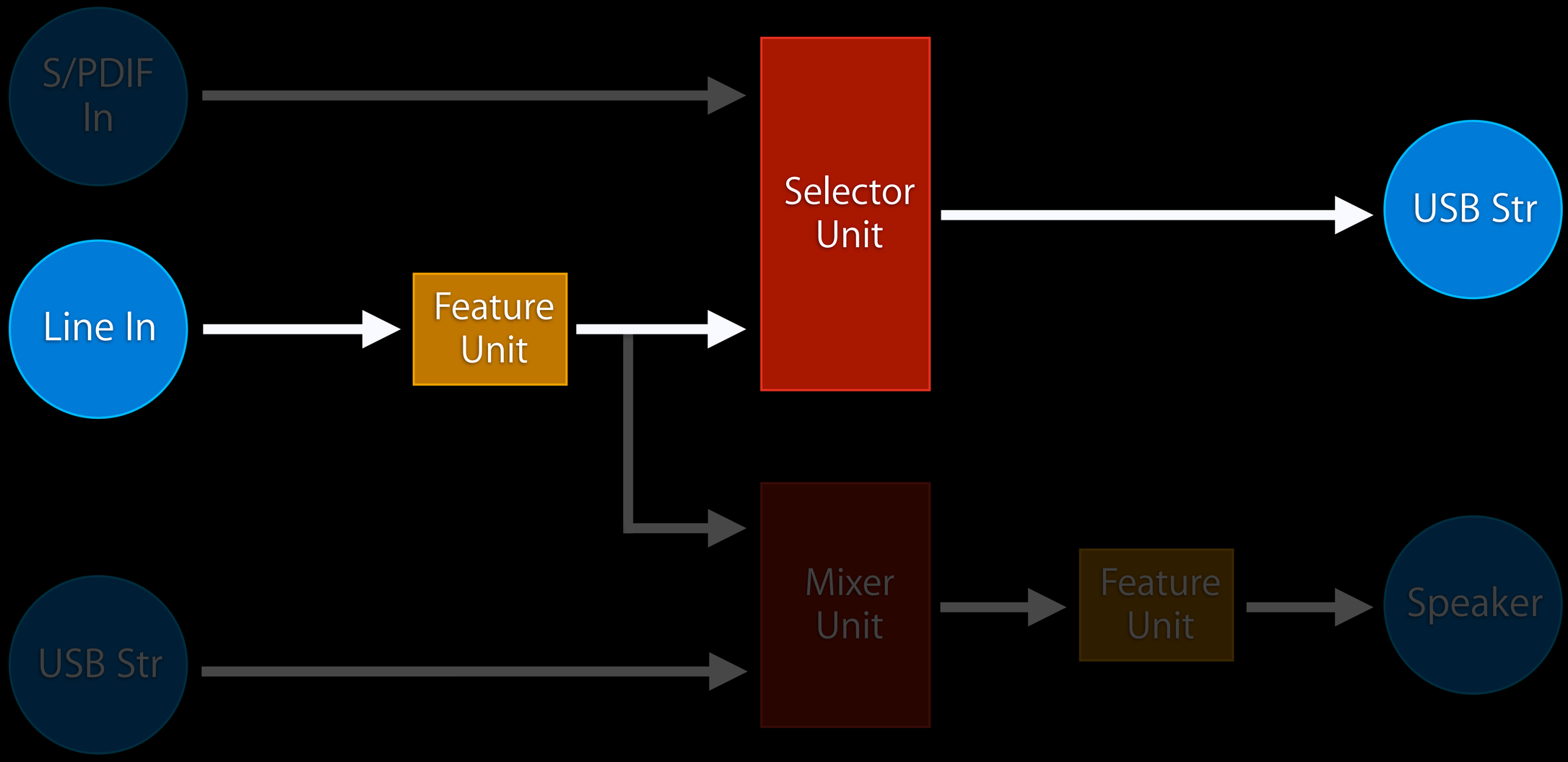

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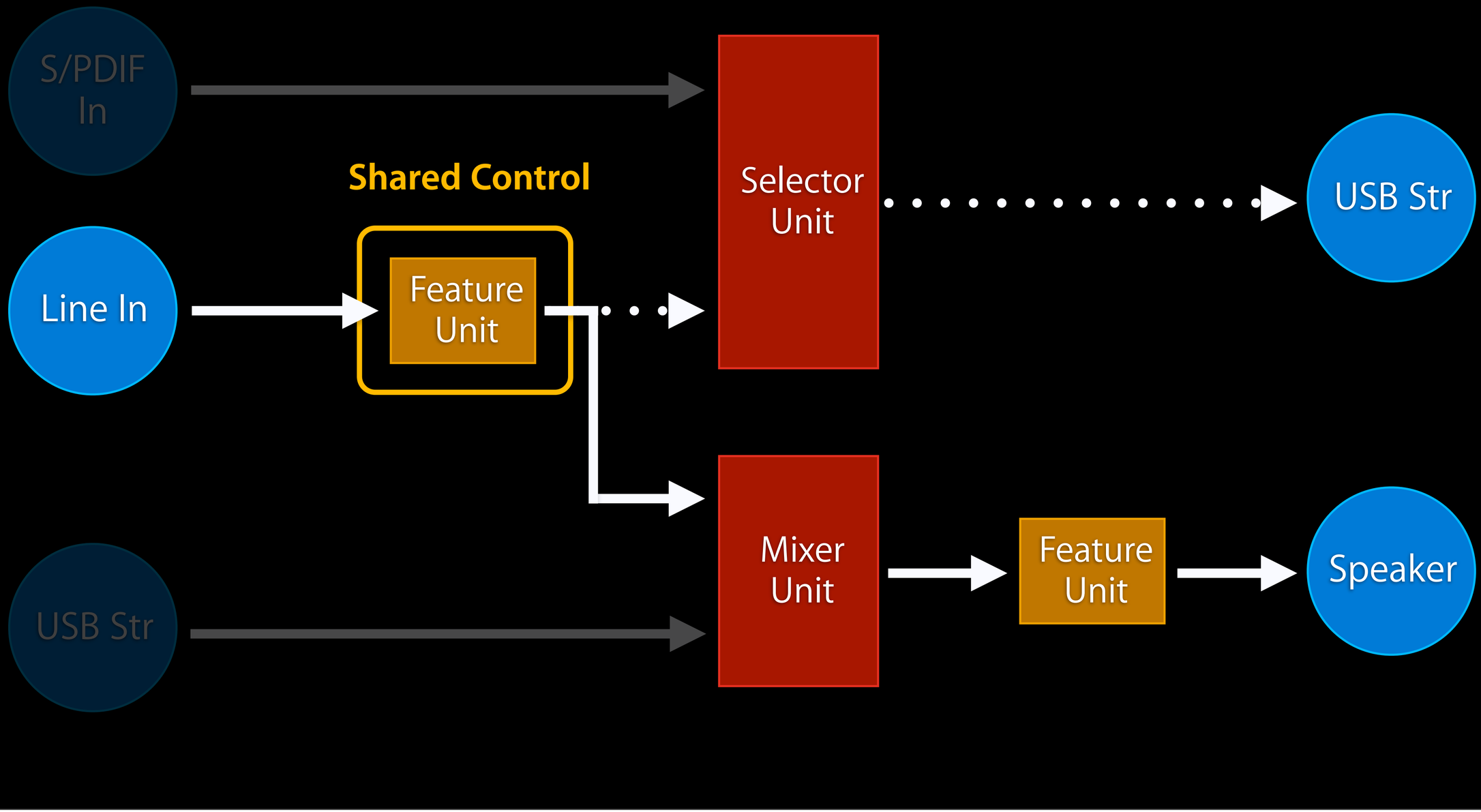
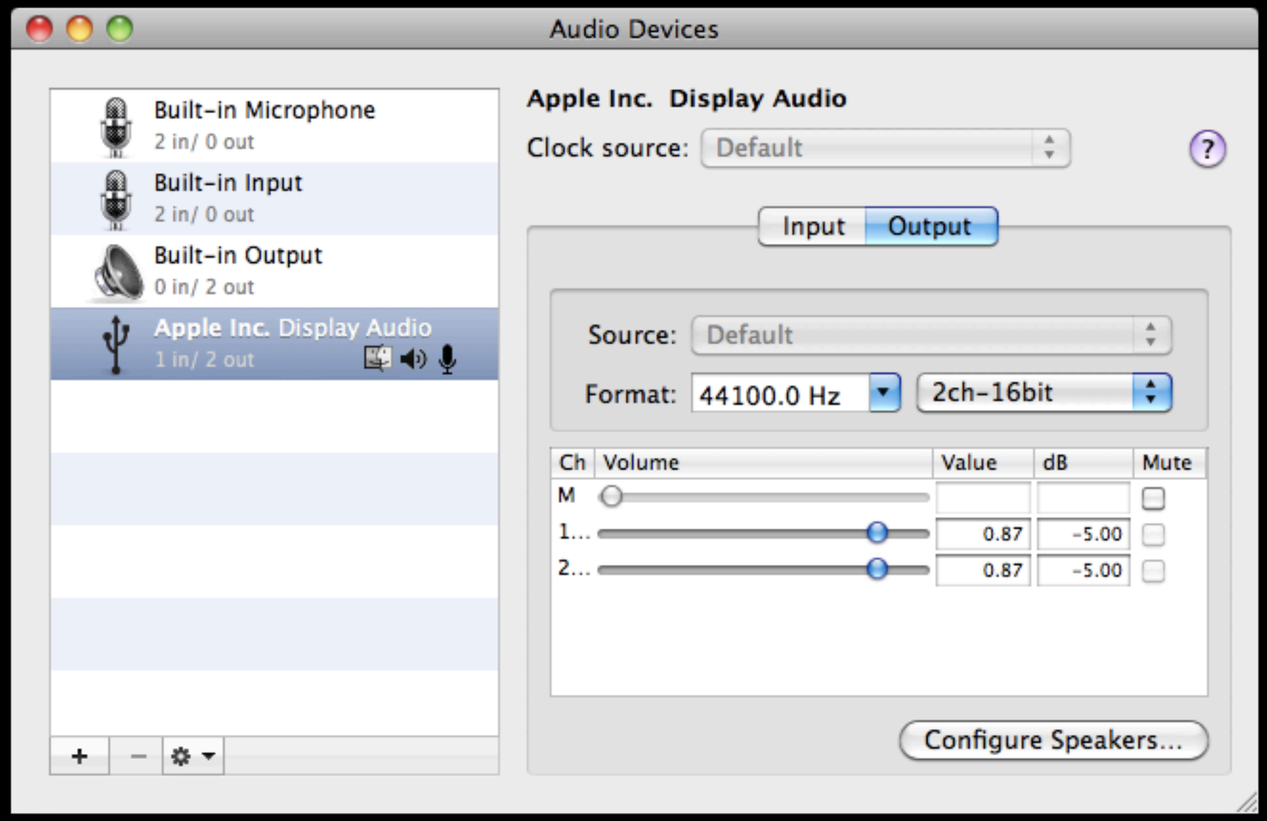


Tip #1: Controls

Status interrupt endpoint

User adjusts volume knob



Volume slider and values updated on Mac

Tip #2: Descriptive Naming

- Engine and device names
- Channel names

Tip #2: Descriptive Naming

Engine and device names

Engine Name =

(1) Stream interface name
or
(2) Control interface name

Device Name =

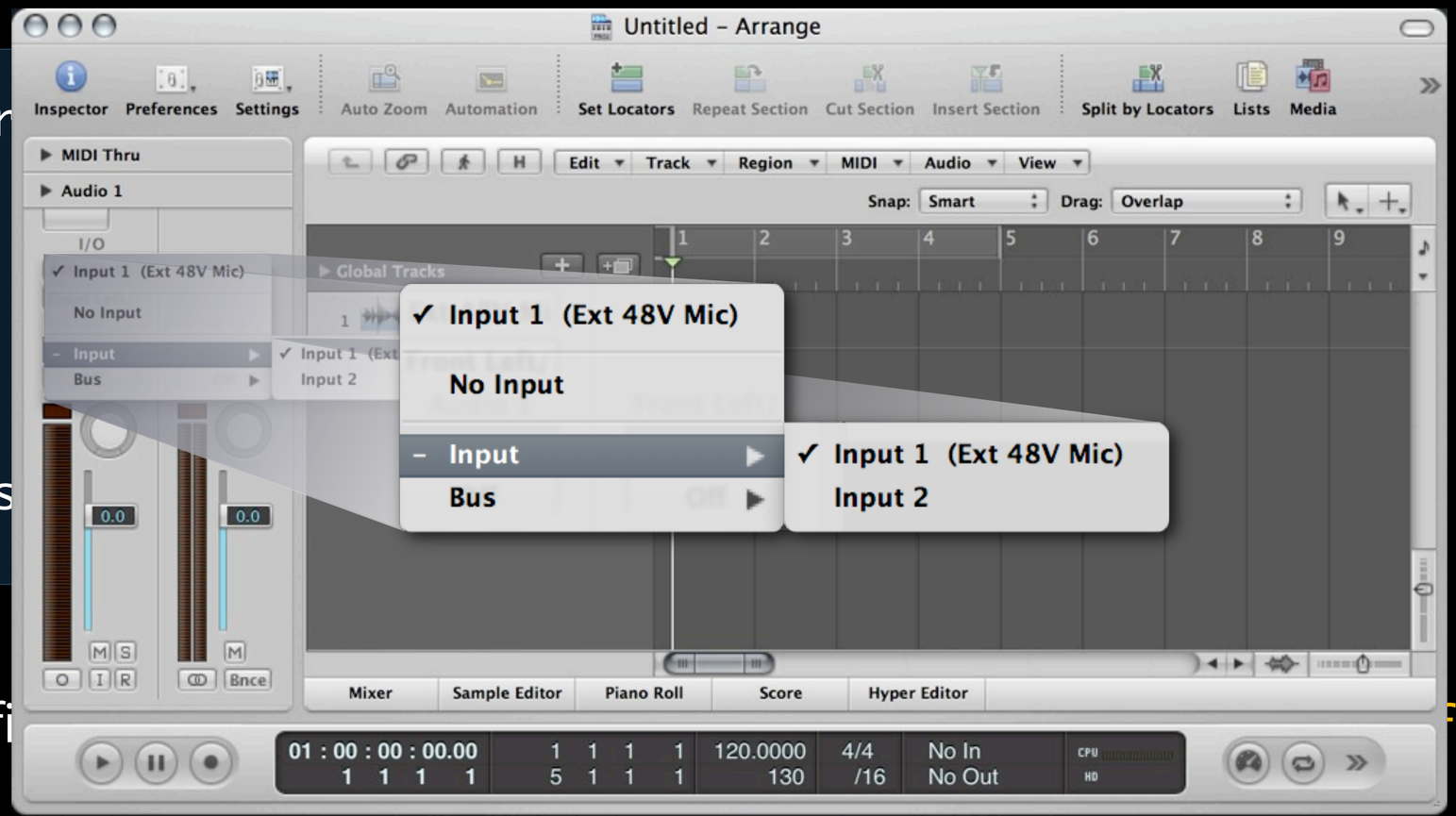
(1) Control interface name
or
(2) Device product name
or
(3) “Unknown USB Audio Device”

Tip #2: Descriptive Naming

Channel names

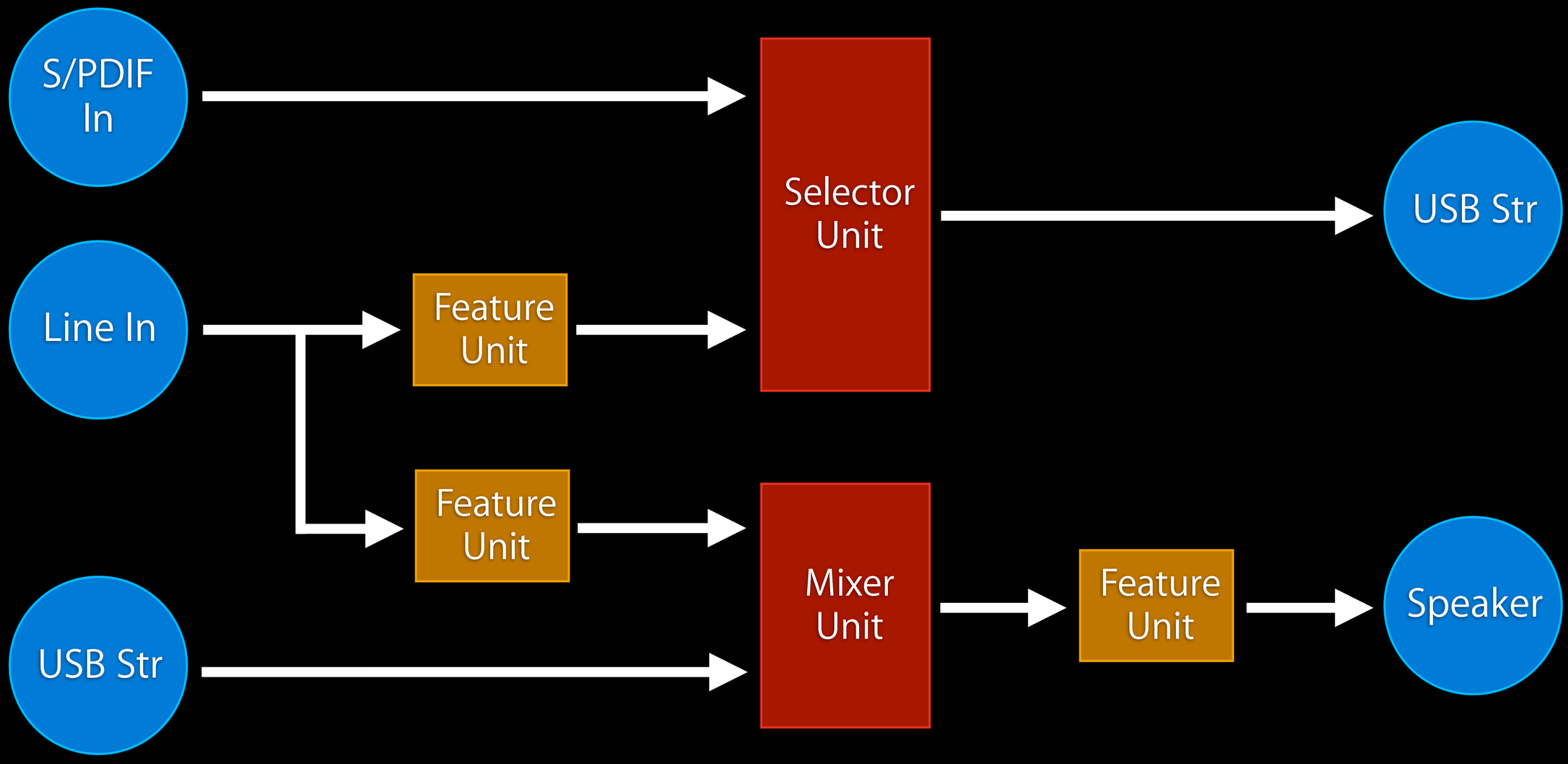
- Predefined spatial locations (FL, FR, FC, LFE, BL, BR, etc.)
- Custom: iChannelNames

```
typedef str

    UInt8
    UInt32
    UInt8

} AudioClus

# non-predefi                                                    fig)
```



Tip #2: Descriptive Naming

Channel names



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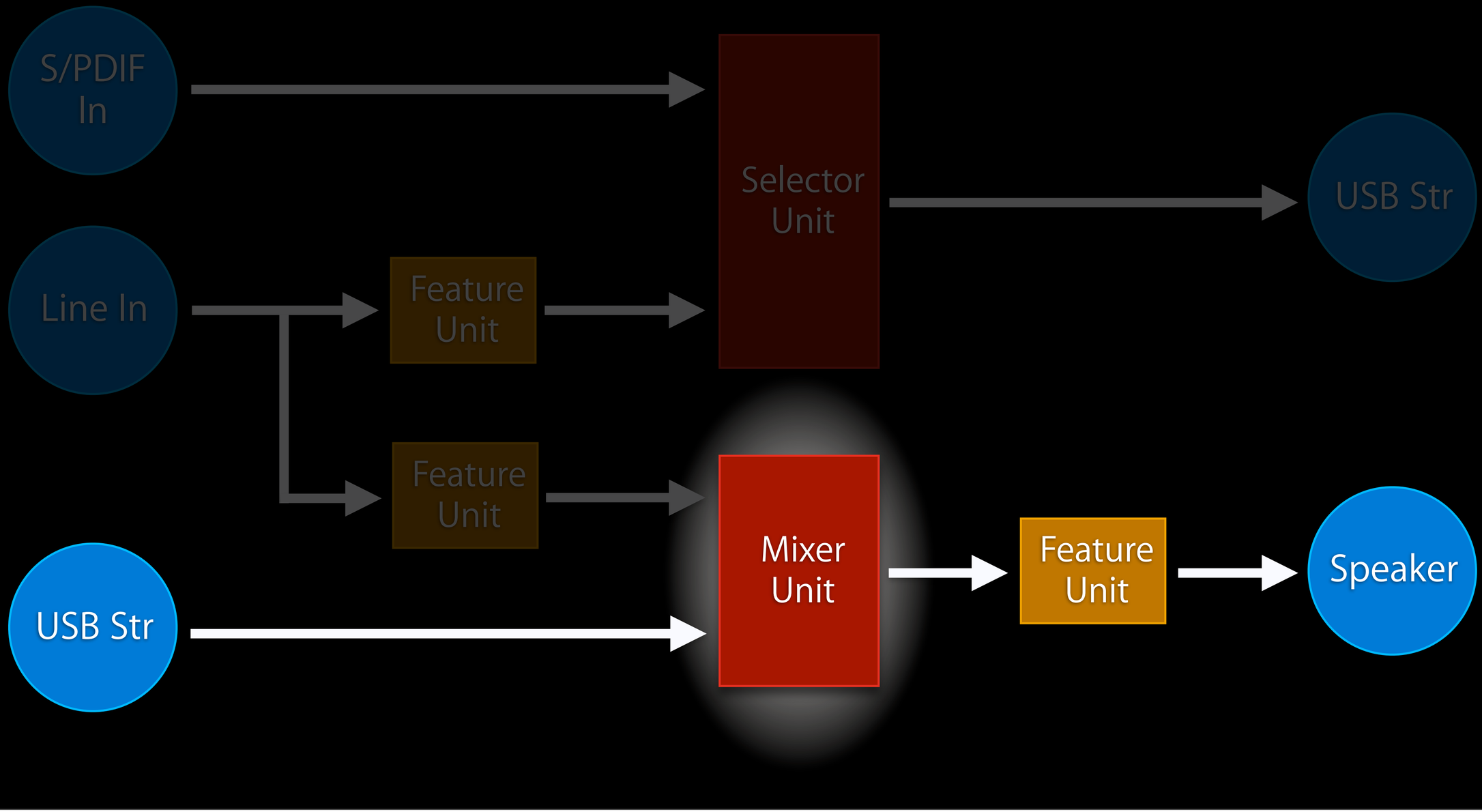

Tip #3: Artifact-Free Streaming

- Endpoint sync types
- Max packet size

Tip #3: Artifact-Free Streaming

Endpoint synchronization types

Synchronous — Synced to host using SOF

Asynchronous — Not synced to host

Adaptive — Synced to host using data rate

Tip #3: Artifact-Free Streaming

Common sync type combos

Input Stream		Output Stream
Synchronous	+	Synchronous
Asynchronous	+	Adaptive
Asynchronous	+	Asynchronous

Tip #3: Artifact-Free Streaming

Max packet size

- Max size variation: +/– 1 sample frame per USB frame (Section 2.3.1.1, 2.0 Audio Data Format Spec)
- Actual bandwidth reserved: Average USB frame size + 1
- Full speed example: 44.1 kHz/2 ch/24-bit

$$\frac{\text{44,100 sample frames/sec}}{\text{1000 USB frames/sec}} = \text{44.1 sample frames/USB frame}$$

Tip #3: Artifact-Free Streaming

Max packet size

- Max size variation: +/– 1 sample frame per USB frame (Section 2.3.1.1, 2.0 Audio Data Format Spec)
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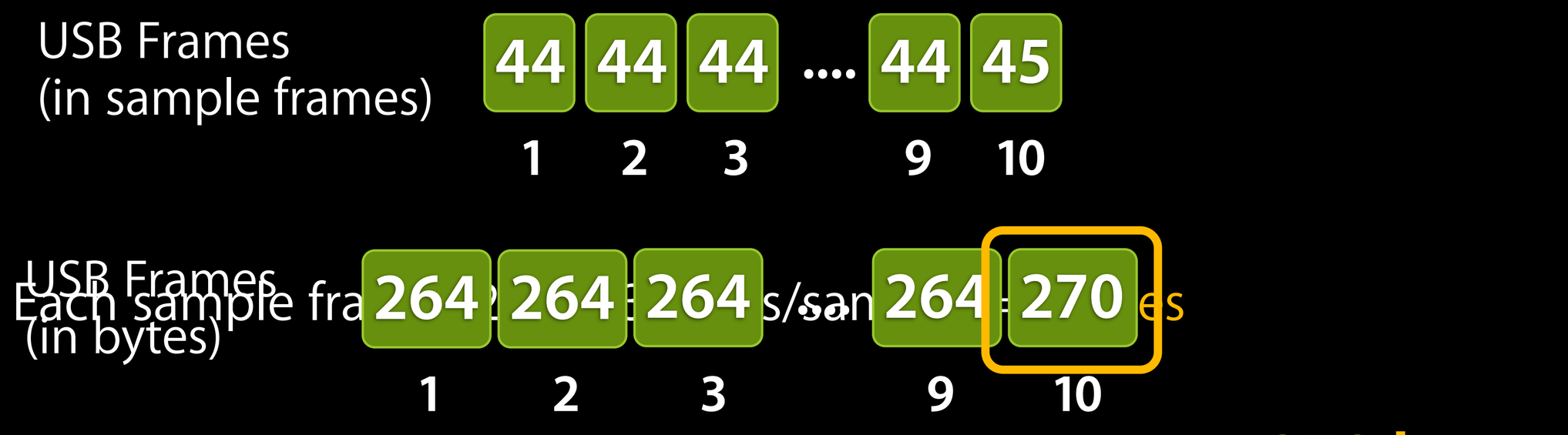


Tip #4: Combine Streams on Single Engine

- New in Software Update 10.5.7
- Why?
  - Streams are synchronized
  - Consistent latency between hot-plugs

Tip #4: Combine Streams on Single Engine

Criteria

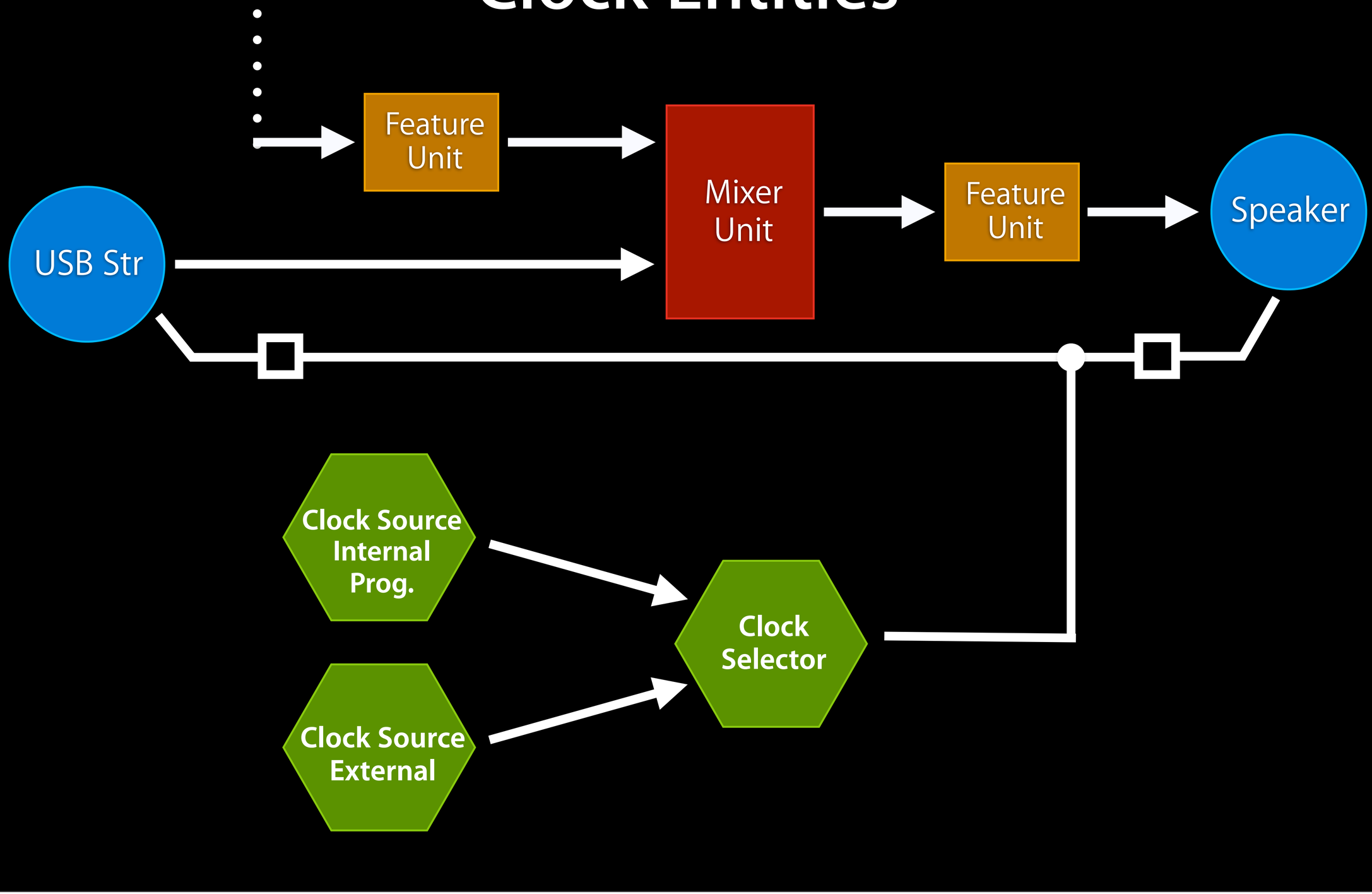
- Same sync type for all interface alternate settings
- Compatible endpoint sync types (i.e., recommended combos)
- Matching sample rate sets
- Streams are in the same clock domain (2.0 only)

2.0 USB Audio in Snow Leopard

2.0 USB Audio in Snow Leopard

- High speed streaming (Section 5.6, 2.0 USB)
  - Full speed: **3 channels @ 96kHz/24-bit**
  - High speed: **24 channels @ 96kHz/24-bit**
- Clock domains and control (Sections 4.7.2.1–4.7.2.3, 2.0 USB Audio)

Clock Entities



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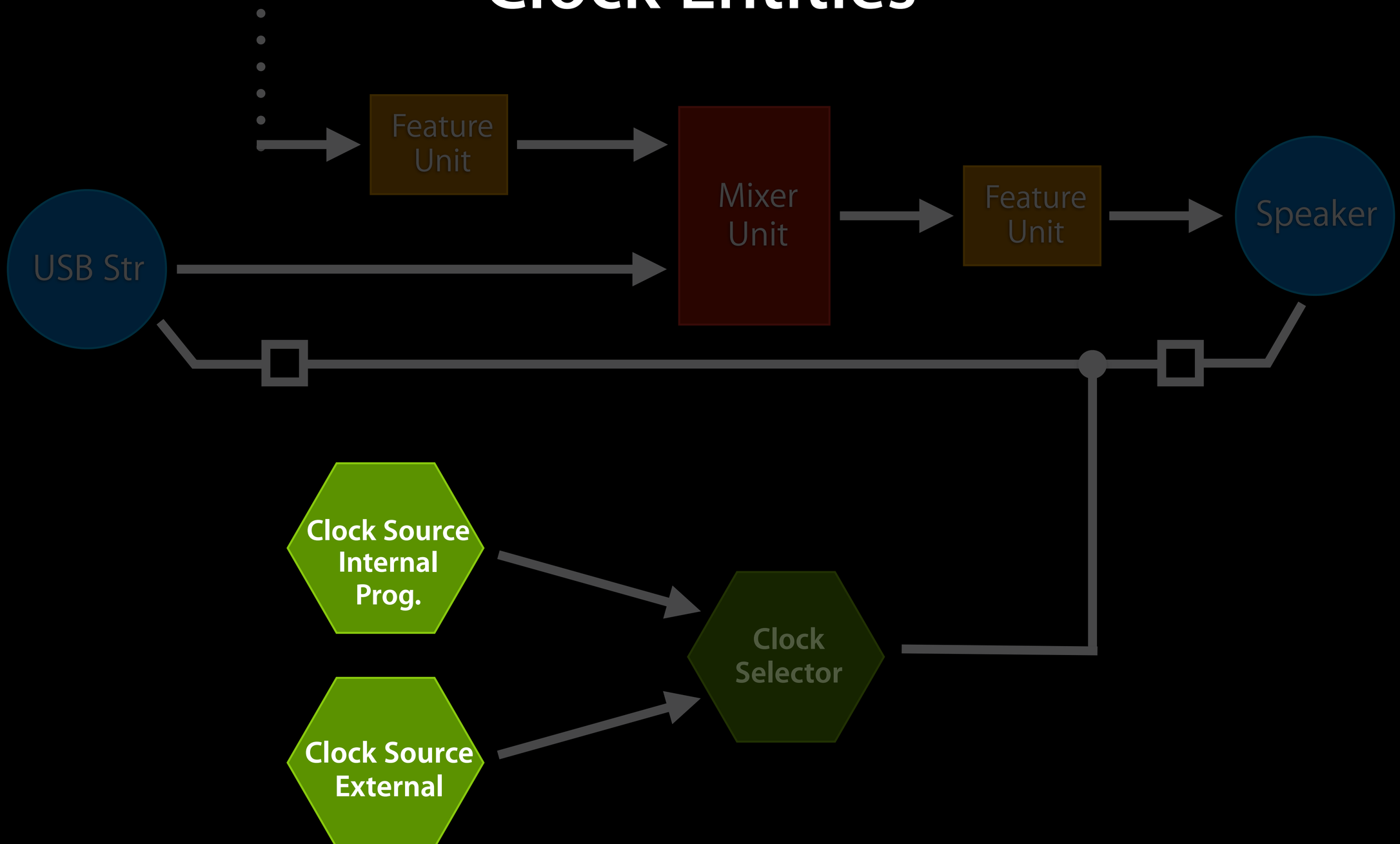

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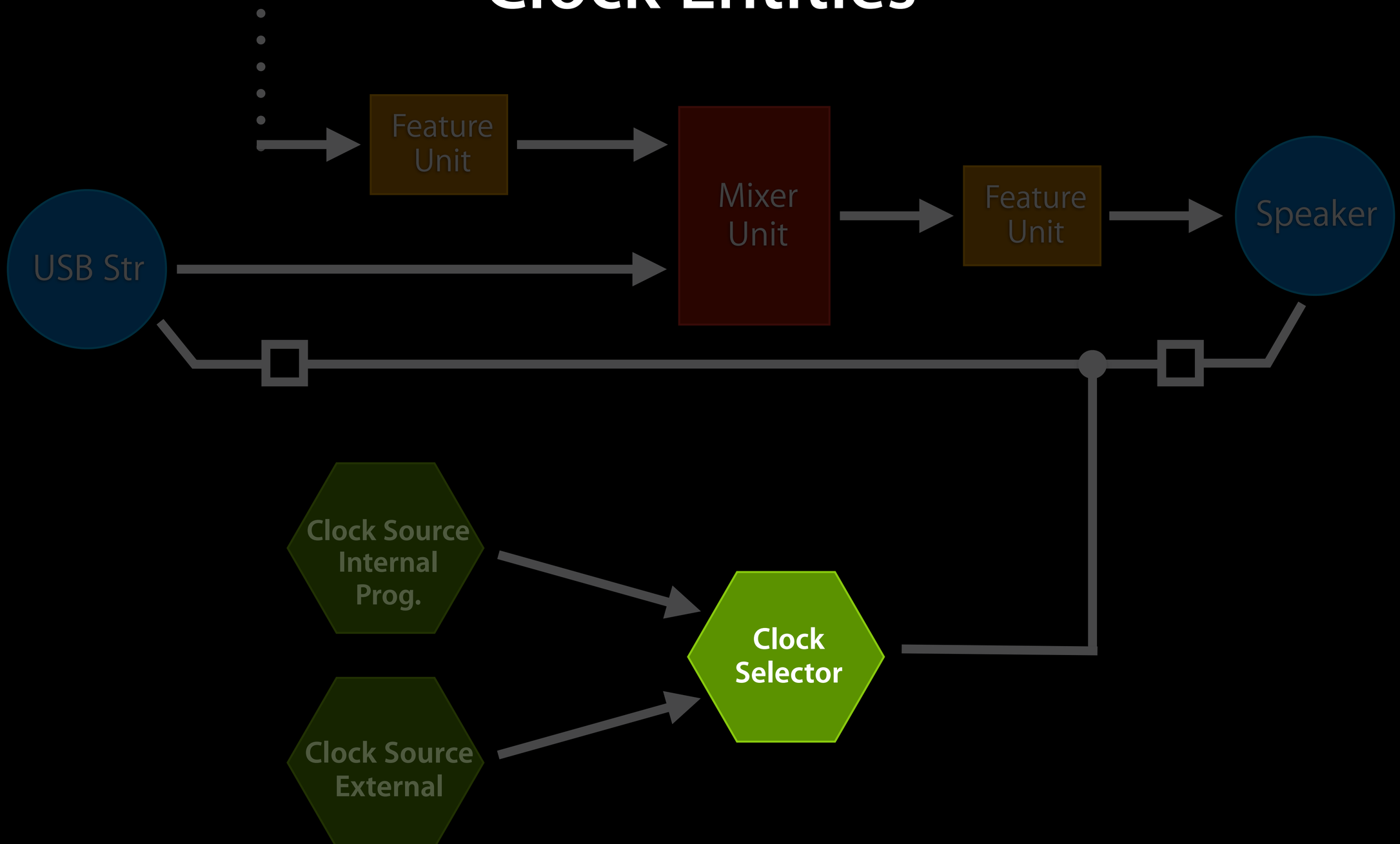
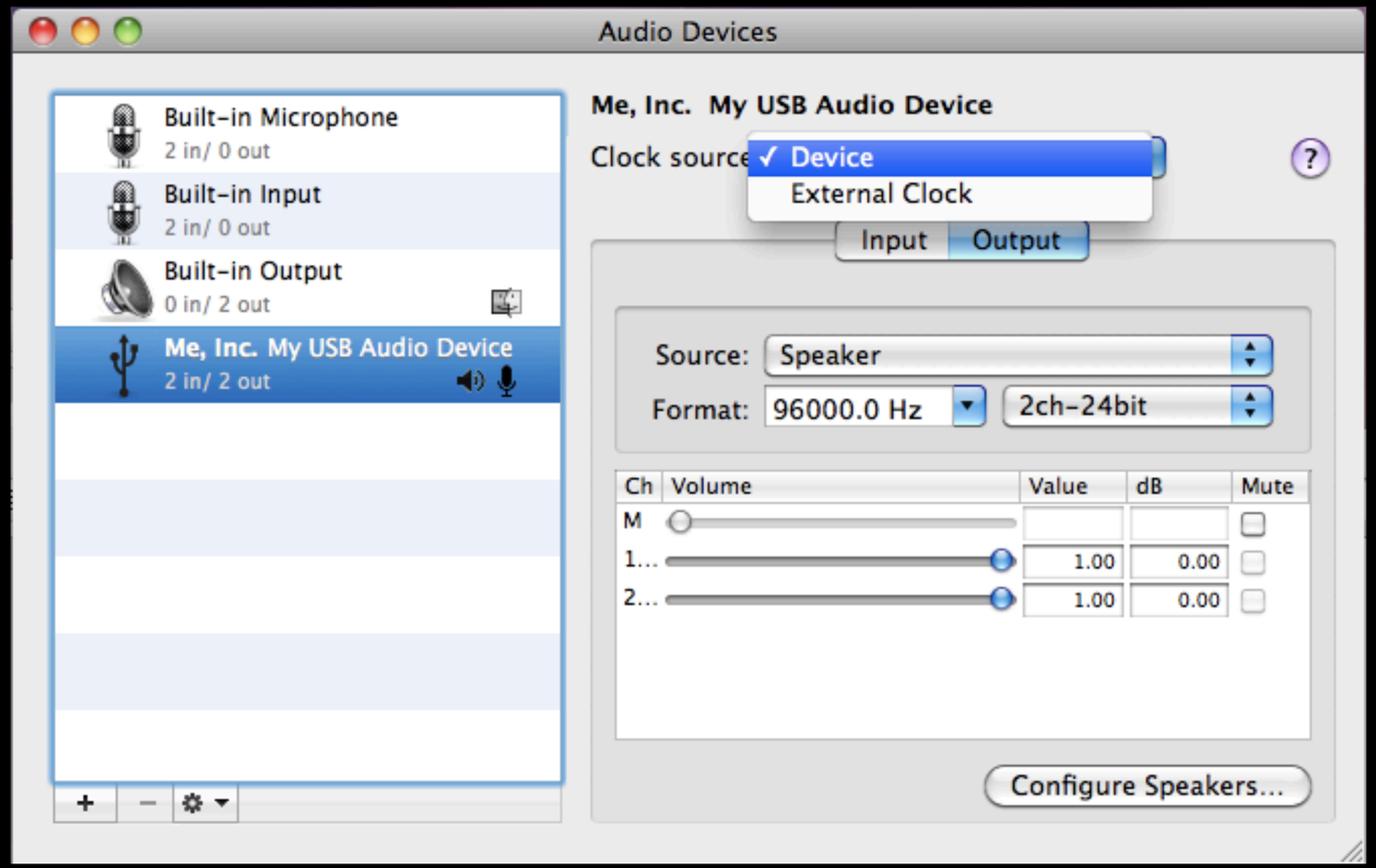


Clock Entities

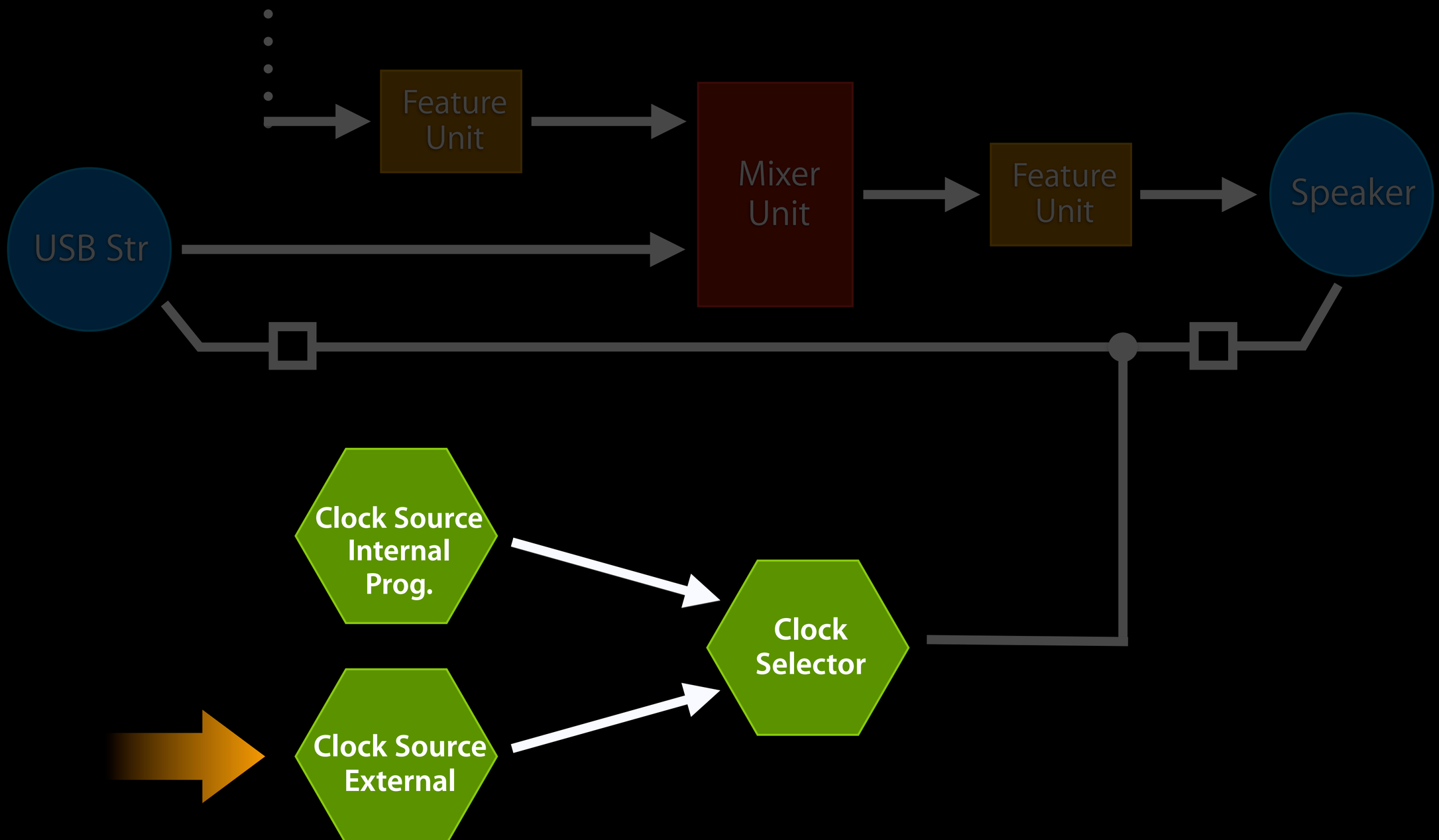
Clock Selector



2.0 USB Audio Features

- High-speed streaming (Section 5.6, 2.0 USB)
- Clock domains and control (Sections 4.7.2.1–4.7.2.3, 2.0 USB Audio)
- IAD: Interface Association Descriptor (Section 4.6, 2.0 USB Audio)
- Status Interrupt: Clock (Section 4.8.2.1, 2.0 USB Audio)

Maintaining Valid Clock Source



Final Thoughts

- Class-compliant devices work best with a Mac
- Choose 2.0 over 1.0 USB Audio

More Information

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I/O Technology Evangelist
keithley@apple.com

Michael Wong
Audio Partnership Manager
wong1@apple.com

Documentation

USB Device Class Definition for Audio Devices, Release 2.0
http://www.usb.org/developers/devclass_docs#approved

Labs

USB and FireWire Lab	OS X Lab B Wednesday 3:30PM
USB and FireWire Lab	OS X Lab D Thursday 12:00PM

Q&A

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WWDC09